SCIENCE.

FRIDAY, APRIL 11, 1884.

COMMENT AND CRITICISM.

A COMMITTEE of the Massachusetts legislature is considering the introduction of an act authorizing the preparation of a topographical map of the state. The U. S. geological survey commenced its work in the state last year by placing a surveying-party in one of the western counties, with the intention of constructing a map of the state, to be printed on the scale of about half an inch to the mile. The director of the survey has now proposed to the committee to double the printed scale, as well as the original plot, making the latter about two inches to the mile, provided the state treasury will bear one-half of the expense, or a sum estimated at five dollars per square mile, — a final total expense to the state (800 square miles along the coast being already charted by the coast-survey) of less than $40,000.

This recalls the movement in the state ten years ago, when the American academy memorialized the legislature for a general survey of the commonwealth, — a project which received the cordial support of scientific, industrial, and educational bodies throughout the state, and which was lost by the casting vote of the speaker of the house. That plan contemplated, on the topographical side, an original map, on the scale of 1 : 25,000, or about two inches and a half to the mile, to be finally printed on some lesser scale. The cost of the field-work was estimated at $25 per square mile, or $175,000. But the plan proposed so much more than the topographical map, that the estimated expense of the entire survey was brought to $385,000; and it was doubtless the magnitude of the total cost which finally defeated the measure.

Half a century ago, a trigonometrical survey was ordered and executed, and a small map prepared. The triangulation was admirably performed by Borden; but the map was a mere patchwork of town-surveyor's work, and, at best, showed only the superficial area, and no topography whatever. Yet it has been a boon to the state, and no one has ever complained of the expense. This survey cost $70,000 when the total valuation of the state was $200,000,000. The present valuation exceeds $2,000,000,000; and a present expenditure of $700,000 would therefore be the equivalent of what was granted to the first survey. An appropriation of $40,000 to obtain what, under any other circumstances, would cost at least $80,000, would be a mere pittance beside this; and it would seem that the reception of the last movement, involving so large an outlay, should encourage the committee of education to believe that the legislature would respond freely to the offer of the director of the government survey.

The difference between a scale of 1 : 25,000, asked for ten years ago, and that of about 1 : 31,680, now proposed, is not great enough to materially affect the delineation of the general topography, and of the distribution of such natural features as are most needed for industrial and scientific purposes. It is not all that could be desired; and provision should be made in any matured plan to enable the commissioners to enlarge the scale in any district which would be ready to pay the additional cost required, as well as to secure for the state a transcript of all original plots. What the state will eventually need will be a far more detailed map. But it is questionable under what auspices such a work should be done, and it is morally certain that it will not be done for a long time to come. And in any case, failure to co-operate now with the U. S. geological survey would be to lose the services of a reliable and experienced corps in a plan offering

specially economical advantages. It would, in short, be wasteful of the public purse.

THE recent glacial studies in the western states, mentioned in our notes, serve to call attention to more than their technical result. Important as this is, we believe a greater value lies in their standing as an example of non-professional work. A problem of the greatest interest has been successfully attacked, not by organized state surveys, but by persevering private enterprise, in time spared from regular pursuits; and success in such an endeavor is a hopeful sign of our progress toward the more popular and practical appreciation of theoretical geology, that has been fairly attained in England and Switzerland. We trust there may be many others working to the same end on the numerous problems that await them. The evidence found by Mr. Wright to suggest the former existence of a glacial dam across the Ohio, so as to form a long, irregular lake above Cincinnati, has been eagerly accepted by some of the Pennsylvania geologists to explain the high-level terraces farther up the river-valley. The southern shore-line of this hypothetical lake remains to be searched for, and, in connection with the physical history of the Ohio, forms a most attractive problem for detailed local study. The shore-lines of the Great Lakes, in the once expanded condition as marked by the lake-terraces, are also subjects for patient tracing from town to town. Scattered observations on them are already old. How long must we wait before local observers give a full picture of these inland seas?

IT is time for a reform in the relations existing between the public and the college-professor, as regards the asking and giving of advice on matters which are not educational in character. We suppose that every professor is willing to answer questions that pertain to education or to pure science, — not only willing, but glad to do so, if there is a fair prospect that the answer will be of real assistance; but it does not follow that he ought to answer questions bearing upon business-matters. Why, for instance, should a chemist known to us be expected to comply with such requests as, 'Please give me a sketch of Glinsky's dephlegmator?' 'Would *papier-maché* be a good substitute for leather in the manufacture of shoe-soles?' 'Please describe an easy method for making a complete analysis of water,' etc.; all of which, besides many others, have been received within a few days past? This amounts to asking for professional advice, and is to be compared with asking the advice of a lawyer or physician. No one expects these gentlemen to dispense their knowledge freely to all comers, and they are protected by the understanding that answers to professional questions involve pecuniary compensation. The clergyman is the only professional man, besides the professor, who is expected to give advice without compensation; but it is not probable that his advice in business-matters is often asked. Advice in spiritual matters he is, no doubt, ever ready to give, as the professor is in educational matters; but if, in addition to being a clergyman, he happened at the same time to be a physician or a chemist, it is not probable that he would feel it to be his duty to answer all questions pertaining to medical or chemical subjects.

The view of the matter here taken may appear to be a mercenary one, but that is not the point we wish to emphasize. We desire simply that the professor should be protected from unnecessary demands upon his time. If it were once understood that he is not expected to give free advice to any one who may care to ask for it, he would be saved a great deal of annoyance, and much time, which could, and presumably would, be put to better use. If the notion could once be spread abroad that a letter asking advice must be accompanied by a certain sum of money, most of the letters of the kind now written would never find their way into the mails, and the world would be the gainer in every way. A simple remedy for the difficulty complained of would appear to consist in ignoring the annoying letters; but experience has shown that this remedy, however simple it

may appear, is by no means satisfactory. The writer of the letter, in which he *may* have enclosed a stamp, though this is supposing an extreme case, receiving no answer, feels himself aggrieved, and writes again ; so that in the end the receiver is forced to answer to protect himself. Is there, then, no remedy? Perhaps not. We nevertheless appeal to the public to bear in mind that the college-professor, however little he may have to do (and it is well known that this is very little), has at least something to do besides answering every question regarding business-matters in which it is thought that his advice may be of aid. Ask him any thing you please in the interests of matters pertaining to education or pure science, but draw the line when it comes to asking for what may fairly be called 'professional advice,' in the sense in which that expression is used by the lawyer and the doctor.

Two of the most unexpected discoveries in the deep-sea soundings during the last campaign of the Talisman, under the supervision of Prof. A. Milne-Edwards, are, first, the discovery of polished and scratched pebbles at a depth of five thousand metres, between the Azores Islands and the coast of France, indicating plainly the existence there of icebergs during the glacial epoch; and, second, of stones with impressions of parts of trilobites also brought up by the trawls. If these rocks with trilobites belonged where found, it will go far to prove the existence of an Atlantis continent during the secondary and tertiary epochs.

As a rule, one would not expect scientific knowledge to be much advanced, or very usefully diffused, by elegant extracts and quotations. But in a small book just issued by Appleton & Co., made up of 'characteristic passages from the writings of Charles Darwin,' Mr. Nathan Sheppard has really produced, in a form at once authentic, brief, and inexpensive, an instructive and very readable account of Darwinian doctrine in the words of its founder. The pieces are put together with no small skill, not in the order of publication, but rather in the order of evolution. It begins with the movements and habits of plants, rises from these to worms, discourses of the variation and struggle for existence of the higher living forms, and so to the highest, —

'The diapason closing full in man.'

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The relations of Didymodus, or Diplodus.

MY reverence for the genius of Professor Cope is so great, and my confidence in his acumen so implicit, that when he assured me, first personally, and then in *Science* (iii. 275), that Didymodus (a substitute for Diplodus) was the proper name for Chlamydoselachus, I was willing to at least concede that the two forms might possibly be related. Knowing, as I did, that different types had been confounded under the name Diplodus, I was content to await the publication of Professor Cope's views before expressing a positive opinion, thinking he might have evidence in reserve which would gainsay what had been before offered. A *résumé* of Professor Cope's observations has just appeared, as promised, in the *American naturalist* for April (xviii. 412, 413), and we are therefore in a position to test his utterances. Notwithstanding the reverence and confidence that I have expressed, I can but think now, that for once Professor Cope has been too hasty, and tripped. I am convinced, not only that Didymodus has no generic nor even family relations with Chlamydoselachus, but that it represents even a different *order*. My belief in Professor Cope's candor equals my other sentiments, and I presume he will discard his first-formed opinion when his attention is called to certain facts.

The history of Didymodus, or Diplodus, is a long one, and is complicated with that of several others. I need only give the salient features.

In 1837 Professor Agassiz (*Poiss. foss.*, iii. 66) described a spine which he believed to have belonged to a fish like the sting-rays, as Pleuracanthus laevissimus. The only example was obtained from the Dudley coal-field.

In 1845 Professor Agassiz (*Poiss. foss.*, iii. 204) made known certain teeth, which he referred to sharks of the family of Hybodonts. Two 'species' were distinguished, D. gibbosus and D. minutus. Both were obtained from the English coal-measures.

In 1848 Professor Beyrich (*Berichte verhandl. k. preuss. akad. wiss.*, 1848) proposed the generic name Xenacanthus for a German carboniferous form referred to Orthacanthus by Goldfuss (1847), but which approached nearer to Pleuracanthus.

In 1849 Dr. Jordan (*Jahrbuch für min. u. geol.*, p. 843) described, under the name Triodus sessilis, a form subsequently ascertained to be identical with the Xenacanthus.

In 1857 Sir Philip de Malpas Grey Egerton (*Ann. and mag. nat. hist.*, xx. 423) contended that the spines of Pleuracanthus belonged to the same fish as the Diplodus teeth, and that Xenacanthus was likewise referable to the same type.

In 1867 Professor Kner (*Sitzb. k. akad. wiss.*, lv. 540–584) published an elaborate memoir, illustrated by ten plates, in which he proved conclusively

that Diplodus and Xenacanthus were generically identical.

In 1883 Professor Cope (*Proc. acad. nat. sc. Philad.*, p. 108) substituted the name Didymodus for Diplodus, because the latter name had been given in 1810 to Sargus by Rafinesque. The distinguished naturalist was evidently unacquainted with the researches of his predecessors.

There is much variation in the dentition of Pleuracanthus (as we shall now call Diplodus, or Didymodus), but it is rather a variation consequent on position in the jaws than specific or generic; and not only 'the species,' but one and the same species, may 'possess two, three, or four denticles,' but not teeth at all like Chlamydoselachus. However, somewhat analogous teeth are those of the type named Diplodus incurvus by Professors Newberry and Worthen (*Pal. Ill.*, vol. ii. p. 62, pl. 4, f. 4). These were very different from Diplodus, and belonged to a genus called Thrinacodus by St. John and Worthen (*Pal. Ill.*, vol. iii. p. 289, pl. 5, f. 1, 2). But whether the animals armed with such teeth resembled Chlamydoselachus may well be doubted.

In fine, the order called Ichthyotomi by Professor Cope appears to be demanded; but it has nothing whatever to do with the Pternodonta or Selachophichthyoidi, and it may not even belong to the selachians (some of its characters are very peculiar, and resemble those of protodipnoans). Further, the order had already been recognized, defined, and named by Lütken. Didymodus, or Diplodus, and Triodus, can be co-ordinated with the spines, Pleuracanthus, Orthacanthus (pt.), and Xenacanthus. All these names are referable to a single *family* (Pleuracanthidae) of the order Xenacanthini of Lütken. The proposed memoir of Professor Cope will, however, be a great boon to science; and to enable him to co-ordinate his data with those of the earlier paleichthyologists, and thus render it still more valuable, is the object of this communication. Apparently two genera, distinguished by their spines, exhibit the Didymodus, or Diplodus, dentition, — Pleuracanthus and Xenacanthus. Information is especially desirable respecting the character of their branchial apertures.

As to Chlamydoselachus, the anatomy will probably reveal a structure most like that of the Opistharthri (Notidanidae), but of a somewhat more primitive type. Mr. Garman's memoir will unquestionably be of great value, for probably no one is better acquainted with the selachians than that gentleman.

THEO. GILL.

The 'unit of time' controversy.

Upon reading your editorial comments in *Science*, No. 58, upon the 'change in the unit of time' controversy, which close with the words "Unless, then, this matter admits of speedy and permanent decision, the one way or the other, with the entire agreement of all parties to the controversy, astronomy would appear to run the serious risk of forfeiting her claim to a place among the exact sciences," it strikes me, that unless the whole thing is intended as a sarcastic criticism of Mr. Stone, of which there is no evidence, it is about time to call a halt upon some one for loose writing.

If Mr. Stone maintains that a mean solar day, instead of depending upon the actual time of rotation of the earth on its axis and the actual time of its revolution round the sun (and hence capable of determination by actual observation), is an arbitrary interval of time fixed by the dictum (of Bessel, Leverrier, or any other human being) that in that time the earth shall move so far in its journey round the sun (and that is exactly what his theory amounts to), and if he says,[1] "Professor Adams's argument, that 'mean solar time is measured, not by the sun's mean motion in longitude, as Mr. Stone's theory supposes, but by the motion of the sun in hour-angle,' is one that I do not profess to understand," and if he persists in maintaining these absurd positions, then astronomers will simply leave him to himself, for argument in such a case is useless.

As to the relation of astronomy to the exact sciences, let us see how much is the point in dispute. The increasing discrepancy between the formulae of Bessel and Leverrier for the annual mean motion of the sun in longitude is $0''.0602$ per year; that is, six-hundredths of a second of arc while the sun moves 1,296,028 seconds. This amounts to eight-hundredths of a second of time ($0^s.08$) in *twenty years*. Expressed as a ratio to the whole constant, it is .000,000,046, or about 1 part in 21,500,000. The discrepancy between the two best modern determinations — those of Hansen and Leverrier — is only $0''.0043$ per year, or about one-fourteenth of the above; and perhaps it will be admitted by even the most enthusiastic devotees of the 'exact sciences' that this is a fairly well determined astronomical constant. The proper theme for exciting astonishment should be, that Bessel, with the data available in his day, should have been able to determine this, and a dozen other constants, so wonderfully near their true values as modern observations show them to be. Only an intellectual giant of his wonderful skill and indomitable energy could have accomplished such results.

H. M. PAUL.

Washington.

[*Caeteris paribus*, loose writing is much less probable than loose reading. We counsel our correspondent to re-read, and with circumspection. *Science* hopes to present the views of all parties when so expressed as to merit a hearing, and, least of all, takes occasion to espouse the cause of a partisan. The controversy on 'the unit of time' is regrettable; but foreign astronomers are abundantly competent to conduct the discussion, as they have done heretofore, without additions to the literature of the subject on the part of any one here.]

The use of the method of limits in mathematical teaching.

Science for March 14 contains a letter by Professor Safford on methods of teaching the calculus, in which he refers to the 'new method of rates' by the writers, in comparison with the method of limits. The phrase, 'new method of rates,' is quoted from a list of subjects for discussion by the M. P. club, Boston, and was probably intended as an abbreviation of the title of a pamphlet, "On a new method of obtaining the differentials of functions, with especial reference to the Newtonian conception of rates or velocities."

We have more recently published a treatise on the differential calculus, founded upon the method of rates or fluxions, in which the method published in the pamphlet is employed in obtaining the differentials of functions, but which has nothing in common with the methods used by Maclaurin, except the employment of the conception of velocity in the fundamental definitions.

Professor Safford regards the doctrine of 'the survival of the fittest' as having pronounced against the method of fluxions, and in favor of the method of limits. It seems to us that it is rather the *geometrical methods* of Maclaurin and the immediate followers of Newton that have thus been condemned, as com-

[1] *Monthly notices*, January, 1884, p. 81.

pared with the analytical methods and more flexible notation adopted by the followers of Leibnitz.

The Leibnitzian notation, although originally connected with the doctrine of infinitesimals, has now been universally accepted; so that we must inevitably denote an absolute velocity by $\frac{dx}{dt}$, and a relative velocity by $\frac{dy}{dx}$. The question which is still, as it seems to us, debatable, is whether these symbols shall be defined (1°) by the conception of a velocity, (2°) as limits of finite differences, or (3°) as the ratios of infinitesimal differences. The second course arose as a protest against the logical difficulties involved in the conception of infinitesimals: it labors under the disadvantage of attaching no separate meanings to the symbols dx, dy, and dt, and thereby loses much of the advantage of the Leibnitzian notation. This method is best exemplified in the excellent treatise of the late Dr. Todhunter. On the other hand, the employment of the notion of rates in the fundamental definitions enables us to give to the detached symbols dx, dy, and dt, definite meanings which are not of necessity infinitesimal.

It appears to us that this method of presenting the subject is better adapted than that of limits to the purposes of elementary instruction. We do not attempt or desire to dispense with the use of limits, as the following quotation from our preface will show: —

"The distinction between the view of the differential calculus here presented, and that found in most of the standard works on the subject hitherto published, may be stated thus: the derivative $\frac{dy}{dx}$ is usually defined as the limit which the ratio of the finite quantities Δy and Δx approaches when these quantities are indefinitely diminished. When this definition is employed, it is necessary, before proceeding to kinematical applications, to prove that this limit is the measure of the relative rates of x and y. In this work the order is reversed; that is, dx and dy are so defined that their ratio is equal to the ratio of the relative rates of x and y: and in chapter xi., by applying the usual method of evaluating indeterminate forms, it is shown that the limit of $\frac{\Delta y}{\Delta x}$, when Δx is diminished indefinitely, is equal to the ratio $\frac{dy}{dx}$. Thus the employment of limits is put off until we are prepared to show that the limit has a definite value, capable of expression in a language already familiar to the student."

Our experience has been, that the student trained by this method finds no difficulty in passing to the employment of infinitesimals, in obtaining the differentials which are required in the mechanical applications of the integral calculus; for example, those required in the determination of moments of inertia, resultant attractions, etc.

J. M. RICE.
W. W. JOHNSON.

U. S. naval academy.

Silk-culture in the colonies.

In your review of my census report on silk-manufacture in the United States, your critic takes issue with me as to the amount of silk raised in the colonies. He declares that there is a tendency on my part "to depreciate the quantity and quality of silk produced, — a tendency which is natural, and doubtless unconscious in an agent of manufacturers." In support of this grave imputation, your critic adduces two points on which he disputes my proof that certain estimates, hitherto accepted as relating to raw silk, really refer to cocoons, and probably to fresh cocoons. He says, first, that I by no means make it clear that the term 'raw silk balls' really meant cocoons, "as it might apply to the twisted hanks of reeled silk, and the term 'cocoons' was in use at that time." To this it need only be said, that, in the literature of the colonial period, cocoons are frequently designated by the term 'balls,' or 'silk balls.' For instance: —

"Removing your branches from the tables, and your silke-balls or bottomes from the branches 5 dayes after the worke is perfected, the balls are then to be made election of for such seed as you will preserve for the year following. Bonoeill and De Serres do both agree that there should be proportioned 200 balls for one ounce of seed, the balls male and female."

On the other hand, in a widely extended reading on the subject, I have never met with the term 'balls' as signifying reeled silk in any form; and I have no reason to believe that reeled silk was made into balls.

Your critic remarks, secondly, "It is certainly not justifiable to assume that the cocoons were necessarily fresh, as they are not thus handled and marketed." They are so handled and marketed at the present day. Statistics of production in European countries and districts are compiled, based on the weight of fresh cocoons. The commerce in them is very large. Quotations of their market-prices appear, during the season, in trade reports and journals. For instance: in the *Moniteur des soies* of June 30, 1883, under the headings 'Prix des cocons Français' and 'Marchés des cocons Italiens,' there are pages of this sort of information; and it is so well understood as referring to fresh cocoons, that no special designation is used for them: they are simply 'cocons.' Indeed, I am assured, on good authority, that it is only fresh cocoons that go from the producers to the filatures: even if 'choked,' they are accounted fresh.

Is it not justifiable to believe that estimates of the weight of cocoons produced in Georgia, and of what was sent to the filature there, were similarly made: that is, that they referred to fresh cocoons? This view of the case came to me only after months of research and final good fortune in tracing the origin of an historical error. Until then, I had accepted without question the current histories in their accounts of silk production in the colonies. My explanation reconciles their strange discrepancies: before refusing it, should not some other solution be offered?

While differing wholly from the conclusions of your article as to the causes of failure and cessation of silk-culture in this country, I should not have troubled you with a reply to criticisms on my work, had they not contained the imputation to which, with great regret, I have deemed it necessary to refer.

WM. C. WYCKOFF.

Rainfall at Amherst, Mass.

The month of February, 1884, stands alone upon the meteorological record of Amherst college in showing an average cloudiness of seventy-seven per cent of the sky. During the forty-two years which this record covers, in no previous case has the cloudiness of a month averaged more than seventy-four per cent; in only five cases has it reached seventy; the range generally being between forty and sixty, and the mean almost exactly fifty.

The fact that clouds and fog gather only in air containing particles of dust, which has been scientifically demonstrated, suggests the question, whether the volcanic dust from Krakatoa, which in higher air gave to us the brilliant evening skies of December last, may not, in its gradual descent toward the earth, have reached in February the lower level, in which our clouds are formed, and have been the cause of this unprecedented accumulation of them.

S. C. SNELL.

Amherst, Mass.

Dr. Newberry's work in the Colorado Cañon.

My attention has been drawn to the fact that the absence of any mention of the earlier explorations of the Colorado Cañon region in the review of Capt. Dutton's monograph (p. 327) does an apparent injustice to these, and particularly to Professor Newberry's work in that district. It is to be regretted that the limit of space available rendered an historical notice of the progress of geological discovery in this remarkable region impossible, while a paragraph in the review, intended to apply merely to the work of the later geological surveys organized as such, may be interpreted as ignoring that of previous government expeditions which antedated these by many years, and were carried out in the face of difficulties and even dangers with which later parties have not had to contend. This was very far from being the intention; and, indeed, Professor Newberry's work in the cañon region is so well known to geologists, and so highly appreciated, that an attempt to ignore it in any complete account of the region could but reflect on the author. THE REVIEWER.

The occurrence of the Hessian fly in North America before the revolution.

The American philosophical society of Philadelphia appointed, in 1791, a committee for the purpose of collecting, and communicating to the society, materials for the natural history of the insect called Hessian fly, as also information of the best means of preventing or destroying the insect, and whatever else relating to the same might be interesting to agriculture.

At a meeting of the committee, April 17, 1792, it was resolved, that for obtaining information of the facts necessary for forming the natural history of this insect, *before its entire evanishment from among us*, it be recommended to all persons whose situation may have brought them into acquaintance with any such facts, to communicate the same by letter, addressed to Thomas Jefferson, esq., secretary of the state to the United states.

Nine questions were proposed, on which information was particularly wanted. I quote here only the first.

"In what year, and at what time of the year, was this animal observed for the first time? Does it seem to have made its appearance in this country only of late years, or are there any reasons for supposing that it was known in any part of the United States previously to the commencement of the late revolution?"

The resolutions of this meeting are printed in full in Carey's *American museum* (Philadelphia, 1792, vol. xi., June, pp. 285-287) by the committee, — Thomas Jefferson, B. Smith Barton, James Hutchinson, Caspar Wistar. The *American museum* was discontinued after 1792. The last volume contains no report of the committee.

As is obvious from the first question, it was at this time not settled whether the insect had been observed here before the revolution, or not. Mr. A. Fitch quotes the publication in the *American museum*, and stated that no report had been made by the committee. The importance of this question, and of a committee with Jefferson at the head, led me to ask Prof. J. P. Lesley whether the old minutes of the Philosophical society contain any unpublished report, or any thing else relating to the Hessian fly. I received from Mr. Henry Phillips, jun., secretary of the society, the following answer, under date of March 28, 1884: —

At the request of Professor Lesley, I have examined our old minutes in reference to the Hessian fly, and append on next page the results of my search. I know *positively*[1] that before the revolution our newspapers are full of communications in reference to the Hessian fly *eo nomine*. I cannot recall to mind any one paper, but I remember perfectly frequently seeing these articles when reading for other purposes. I cannot find that the committee ever reported.

Extracts from the minutes.

1768, May 18. Com. on husbandry to consider whether any method can be fallen upon for preventing the damage done to wheat by the Hessian fly. *N.B.* — Mr. DuHamel has written on the subject.

1768, June 21. Paper on the Hessian fly read by Dr. Bond; ordered to be published. See No. 4, original papers.

1768, Oct. 18. Col. Landon Carter, Sabine Hill, Va. Observations on the fly weevil destructive to wheat; ordered to be published. [Is published in vol. i. of the transactions of the society. Cf. Harris, Injur. ins., p. 502. DR. H. A. H.]

1791, April 15. Jefferson, Dr. Barton, Hutchinson, Thomson, and Dr. Wistar, a committee to collect materials for forming the natural history of the Hessian fly, and the best means for its prevention and destruction. [Do not find this committee ever reported. H. P.]

1791, Aug. 19. Memoir on Hessian fly by T. L. Mitchell of Long Island read.

Everybody conversant with our actual knowledge and the literature on the Hessian fly, will acknowledge it to be excusable that I took the liberty to again ask Mr. Phillips if by chance the year 1768, together with the name Hessian fly, was not a clerical error; the more so, as Mr. Morgan in Dobson's Encyclop. (vol. viii. p. 491) states, "The name of Hessian fly was given to this insect by myself and a friend early after its first appearence on Long Island."

To day I received from Mr. Phillips the following letter, dated April 1, 1884: —

1. 1768 is not an error. It occurs in the proper place in the old MS. vol., and there can be *no doubt* about the fact. *Similiter* the words *Hessian fly*.

The term came in use in Pennsylvania from the early German immigrants long before the revolution. I am *sure* the term occurs in our Pennsylvania gazettes long prior to that period.

2. Cannot say if that paper (of Dr. Bond) was ever published. Possibly in some gazette *pro bono publico*. There is no clerical error as to the date and name.

Dobson is certainly incorrect in the statement you quote. [Mr. Morgan's pretension to have given the name Hessian fly. Dr. H. A. H.]

At this writing it is not an easy matter for me to *verify* my own statement as to the communications which I have seen in the early Pennsylvania gazettes before the revolution. I have had great use often in days past for historical researches, and the recurrence of the name of the Hessian fly in these early days was a frequent matter of conversation with me and friends, friends of two generations older than myself. While I am perfectly convinced that my memory is accurate, yet a statement of that nature should be verified for historical use. I regret I have not the present opportunity of so doing; yet, in view of the minutes of 1768 bearing upon the matter, I don't doubt the accuracy of my memory, although it was *obiter*.

The importance of these letters is an excuse for their publication, which is done with the permission of the writer. DR. H. A. HAGEN.

Cambridge, April 2.

[1] The Italics are by Mr. H. Phillips.

A spider's device in lifting.

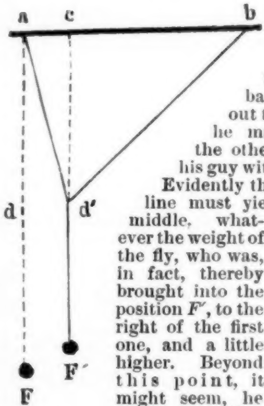
The interesting description by Mr. Larkin (*Science*, No. 58) of the lifting by a spider of a large beetle to its nest reminds me of quite another device by which I once saw a minute spider (hardly larger than the head of a pin) lift a house-fly, which must have been more than twenty times its weight, through a distance of over a foot.

The fly dangled by a single strand from the cross-bar of a window-sash, and, when it first caught my attention, was being raised through successive small distances, of something like a tenth of an inch each; the lifts following each other so fast, that the ascent seemed almost continuous. It was evident that the weight must have been quite beyond the spider's power to stir by a 'dead lift;' but his motions were so quick, that at first it was difficult to see how this apparently impossible task was being accomplished. I shall have to resort to an illustration to explain it;

for the complexity of the scheme seems to belong less to what we ordinarily call instinct than to intelligence, and that in a degree we cannot all boast ourselves.

The reader who questions the propriety of the last remark may be invited to pause, before hearing the spider's device, to consider how *he* would proceed to lift a whole ox hanging vertically beneath him at the end of a hundred-fathom cable, if he had no appliances whatever except some spare rope.

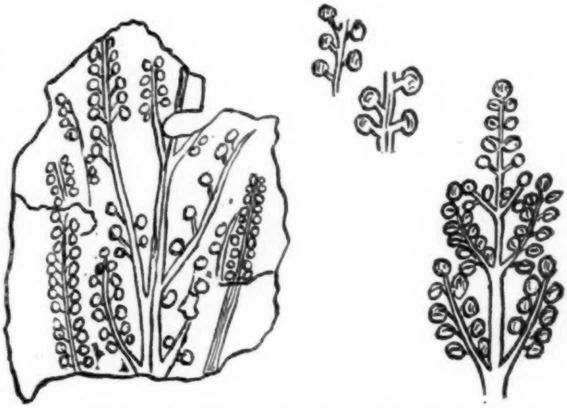
The little spider proceeded as follows (*ab* is a portion of the window-bar, to which level the fly was to be lifted from his original position at *F*, vertically beneath *a*): the spider's first act was to descend halfway to the fly (to *d*), and there fasten one end of an almost invisible thread; his second, to ascend to the bar and run out to *b*, where he made fast the other end, and hauled on his guy with all his small might. Evidently the previously straight line must yield somewhat in the middle, whatever the weight of the fly, who was, in fact, thereby brought into the position *F′*, to the right of the first one, and a little higher. Beyond this point, it might seem, he could not be lifted; but the guy being left fast at *b*, the spider now went to an intermediate point (*c*) directly over his victim's new position, and thence spun a new vertical line from *c*, which was made fast at the bend (at *d′*), after which the now useless portion *a d′* was cast off, so that the fly now hung vertically below *c*, as before below *a*, *but a little higher*.



The same operation was repeated again and again, a new guy being occasionally spun, but the spider never descending more than about halfway down the cord, whose elasticity was in no way involved in the process. All was done with surprising rapidity. I watched it for some five minutes (during which the fly was lifted perhaps six inches), and then was called away. L.

Two species of tertiary plants.

In looking over the plates of Mr. L. Lesquereux's Tertiary flora (U. S. geol. and geogr. surv., F. V. Hayden in charge), I noticed on plate xiv. a figure which seemed to have a familiar appearance. It was like the fruiting-frond of a fern, but the explanation called it Caulinites fecundus, Lesqx. The description on p. 101 referred to it as probably representing the undeveloped flowers of some palm. Turning to Gray's Botany, plate xviii., I was struck with the resemblance between his figure of Onoclea sensibilis and that given by Mr. Lesquereux. I have shown the two species side by side in fig. 1, and there is no doubt in my mind that the Caulinites fecundus is nothing but a part of the fertile frond of Onoclea sensibilis.



a, Caulinites fecundus, Lesqx. Fig. 1. *b*, Onoclea sensibilis, L.

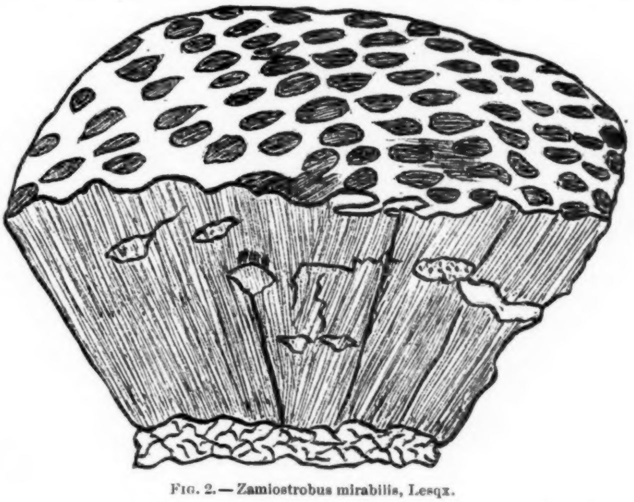


Fig. 2.— Zamiostrobus mirabilis, Lesqx.

In the Annals of the lyceum of natural history, New York, vol. ix. p. 39, Dr. Newberry records the finding of the sterile fronds of Onoclea sensibilis in strata of miocene age at Fort Union, Dakota. He considers that "there is little room for doubt, . . . that during the miocene age a species of Onoclea flourished in the interior of our continent, of stronger habit than either of the living varieties, and holding a mid-

dle position between them." He has based his determination of the species upon the sterile fronds only; but in the figure of Lesquereux we have the fertile frond, or a portion of it, of the same species. This fragment was found at Erie, Col. Should not the Caulinites fecundus be considered Onoclea sensibilis?

On plate lxiii. of the same volume we have a fossil called Zamiostrobus mirabilis, and on p. 70 is the description. Mr. Lesquereux has referred the fossil to the Gymnospermae, and considers it probably to be the cone of one of the Zamieae. Compare. now, the copy of his figure (fig. 2) with that of the longitudinal section of the fruit of Nelumbium luteum (fig. 3), and the resemblance is striking, — so striking is it, in fact, that I do not hesitate to say that both belong to the same genus. Mr. Lesquereux's specimen was found on the surface at Golden, Col.

FIG. 3. — Longitudinal section of Nelumbium luteum.

Turning to p. 252 of the same volume, we find two species of Nelumbium described from the leaves. One was found at Golden, and the other at Sand Creek, Col. The fact of finding leaves of a Nelumbium in the same locality as the fossil here figured, strongly comfirms the idea that the Zamiostrobus is only the capsular fruit of a Nelumbium, probably that described as N. Lakesii. It differs only slightly from the other species, N. tenuifolium; and the two should probably be united. JOS. F. JAMES.

Spool-shaped ornaments from mounds.

As the spool-shaped copper ornaments occasionally found in mounds — one of which is figured by Dr. Rau (*Arch. coll. U. S. nat. mus.*, p. 61, fig. 235), and others by Professor Putnam (*Rep. Peabody mus.*, xv. 110, figs. 18 and 19) — have attracted the attention of archeologists, it may not be amiss to notice some additional specimens of the same kind, recently obtained by the assistants of the bureau of ethnology.

Three of these were obtained by Dr. Palmer, of Mr. J. D. Miller, Marshall county, Ala., who discovered them in an ancient grave in that county. As yet no description of the grave, nor any further statement as to the conditions under which they were found, has been obtained.

These copper spools, as also the others to be mentioned, are of the form represented in the figures alluded to, consisting of two concavo-convex disks joined together by a hollow cylindrical axis. One of the specimens is quite perfect. The disks are one and a half inches in diameter, formed of copper plate that is very smooth and even throughout. The hollow cylindrical axis is about seven-tenths of an inch long, and a little less than two-tenths of an inch in diameter, and has the ends slightly expanded outside of the disks, so as to hold the latter in position. The other specimens found by Mr. Miller are of larger size; being about two inches in diameter, and closely resembling that figured by Professor Putnam. The plate is not more than half the thickness of that of which the preceding specimen was made, being almost as thin as writing-paper; but the cylindrical axis is of the same form and dimensions.

The method of connecting and fixing the disks in these, as will be seen from the description, is slightly different from that described by Professor Putnam. The cylindrical axis is simply passed tightly through the holes made in the centre of the disks, and the ends expanded, as though done with a punch, so as to clasp the outer faces.

Four other specimens, very similar to that figured by Professor Putnam, were discovered by Mr. Middleton in a mound in Jackson county, Ill. The mound in which these were found is one of a group situated in the Mississippi bottom, a short distance from Grand Tower: it is about ninety feet in diameter, and six feet high. In excavating it, human bones were found at all depths, from six inches to six feet below the surface. Below this no human bones were observed; but at the depth of nine feet, that is, three feet below the original surface of the ground, some animal bones were discovered.

The copper specimens were found at the depth of three feet, lying by the side of a skeleton. The four are of the same form and size, being about one inch and a half in diameter: the axis is short, bringing the disks rather closer together than usual, the attachments being as described by Professor Putnam. All the specimens mentioned, except the first, are much corroded and very brittle. The first is also somewhat corroded, but not to the same extent as the others, and is probably the best formed and most perfect specimen of the kind so far discovered. CYRUS THOMAS.

[These so-called 'spool-shaped ornaments' have been shown by Mr. Putnam to be enormous ear-studs, his examinations of the altar-mounds in Anderson township, O., having brought to light over thirty made of copper, together with figurines in which similar objects were *inserted in the ears*. See *Science*, i. 348, 349.]

Unio forms a byssus.

If your correspondent at Holston River, Va., will consult my 'Observations on the genus Unio,' he will find most of his queries answered. The subject is treated in vols. i., iii., vi., x., xi. The byssus is not attached to the shell, but to the foot of the included soft parts. ISAAC LEA.

Philadelphia, March 24, 1884.

Illusive memory.

James Sully, in his 'Illusions,' suggests that a good way of testing for recollections of ancestral experience would be to find out whether children of seafaring men, who have been brought up far from the coast, have the feeling, when they first see the sea, of having seen it before.

Paul Radestock seems to consider that the question is settled by the fact, that while he was writing his

book, 'Schlaf und Traum,' and keeping a record of his dreams, whenever he had a dim idea that he had seen an object or had a thought before, he generally found that his dreams had contained something like it. But he overlooks the consideration that the dream, as well as the feeling, might have been a case of inherited recollection. C. L. F.

Baltimore, March 24.

The reproduction of Clathrulina elegans.

An article with this title (*Science*, iii. 303), by Dr. Stokes, contains two errors, to which his attention is courteously directed, and which are evidently founded upon an incorrect abstract of Miss Foulke's paper. Dr. Stokes says Miss Foulke's statements are "apparently confined chiefly to a process by quadruple subdivision of the body into uniflagellate organisms as observed by herself, with allusions to three additional processes as observed by others." Of the four processes described by the writer, three were first described by her, the fourth being that described by Cienkowski. Again: in the last paragraph is an error resulting from the position of the quotation-marks, which would seem to classify one of the writer's observations with those of Dr. Stokes. Colonies are also formed by the Actinophrys form of young, and the dissemination of the species is carried on as well by the uniflagellate as by the bi-flagellate organisms. These observations should teach us how varied may be the forms assumed by one animal.

Sara Gwendolen Foulke.

WHAT IS A LIBERAL EDUCATION?

I do not intend, in the present paper, to enter upon the disputed question between the advocates of classical culture on the one hand, and those of scientific training on the other; because it seems to me that the line on which the two parties divide is not that which really divides the thought of the day. If we look closely into the case, we shall see that the objects of a higher education may be divided into three classes, instead of the two familiar ones of liberal and professional. In fact, what we commonly call a liberal education should, I think, have two separate objects. With the idea of a professional education we are all familiar: it is that which enables the possessor to pursue with advantage some wealth-producing specialty. Although, in accordance with well-known economic principles, it is designed to make the individual useful to his fellow-men, the ultimate object in view is the gaining of a livelihood by the individual himself. On the other hand, the object had in view in what is commonly known as culture, is not the mere gaining of a livelihood, but the acquisition of those ideas, and the training of those powers, which conduce to the happiness of the individual. From this point of view, culture may be considered an end unto itself.

The third object which we have to consider is only beginning to receive recognition in the eyes of the public. It is the general usefulness of the individual, not merely to himself and to those with whom he stands in business relations, but to society at large. Modern thought and investigation lead to the conclusion, that man himself, the institutions under which he lives, and the conditions which surround him, are subject to slow, progressive changes; and that it depends very largely on the policy of each generation of mankind whether these changes shall be in the way of improvement or retrogression. During the next fifty years all of us will have passed from the stage of active life, and the course of events will be very largely directed by men who are still unborn. The happiness of those men is, from the widest philanthropic point of view, just as important as the happiness of those who now inhabit the earth; and, in the light of modern science, we now see that that happiness depends very largely upon our own actions. We thus have opened out to us an interest and a field of solicitude in which we need the best thought of the time. The question is, what form of education and training will best fit the now rising generation for the duty of improving the condition of the generation to follow it?

Let it be understood that we are now speaking, not of the education of the masses, but of that higher education which is necessarily confined to a small minority. So far as I am aware, that fraction of the male population which receives a college education is not far from one per cent. To that comparatively small body we must look for the power which is to direct the society of the future, and by their acts to promote the well or ill being of the coming generation. Our duty to that generation is to so use and train this select body as to be of most benefit to the men of the future. What is the training required? I reply by saying that I know nothing better for this end than a wide and liberal training in the scientific spirit and the scientific method. The technicalities of science are not the first object; and, so far as they are introduced, it is only as media through which we may imbue the mind with certain general and abstract ideas. If called upon to define the scientific spirit, I should say that it was the love of truth for its own sake. This definition carries with it the idea of a love of exactitude, — the more exact we are, the nearer we are to the truth. It carries with it a certain independence of authority; because, although an adherence to authoritative propositions taught us by our ancestors, and which we regard as true, may, in a certain sense, be

regarded as a love of truth, yet it ought rather to be called a love of these propositions, irrespective of their truth. The lover of truth is ready to reject every previous opinion the moment he sees reason to doubt its exactness. This particular direction of the love of truth will lead its possessor to pursue truth in every direction, and especially to investigate those problems of society where the greatest additions to knowledge may be hoped for.

Scientific method we may define as simply generalized common sense. I believe it was described by Clifford as organized common sense. It differs from the method adopted by the man of business, to decide upon the best method of conducting his affairs, only in being founded on a more refined analysis of the conditions of the problem. Its necessity arises from the fact, that, when men apply their powers of reason and judgment to problems above those of every-day life, they are prone to loose that sobriety of judgment and that grasp upon the conditions of the case which they show in the conduct of their own private affairs. Business offers us an example of the most effectual elimination of the unfit and of 'the survival of the fittest.' The man who acts upon false theories loses his money, drops out of society, and is no longer a factor in the result. But there is no such method of elimination when the interests of society at large are considered. The ignorant theorizer and speculator can continue writing long after his theories have been proved groundless, and, in any case, the question whether he is right or wrong is only one of opinion.

I ask leave to introduce an illustration of the possibilities of scientific method in the direction alluded to. Looking at the present state of knowledge, of the laws of wealth and prosperity of communities, we see a great resemblance to the scientific ideas entertained by mankind at large many centuries ago. There is the same lack of precise ideas, the same countless differences of opinion, the same mass of meaningless speculation, and the same ignorance of how to analyze the problem before us in the two cases. Two or three centuries ago the modern method of investigating nature was illustrated by Galileo, generalized by Bacon, and perfected by Newton and his contemporaries. A few fundamental ideas gained, a vast load of useless rubbish thrown away, and a little knowledge how to go to work acquired, have put a new face upon society. Look at such questions as those of the tariff and currency. It is impossible not to feel the need of some revolution of the same kind which shall lead to certain knowledge of the subject. The enormous difference of opinion which prevails shows that certain knowledge is not reached by the majority, if it is by any. We find no fundamental principles on which there is a general agreement. From what point must we view the problem in order to see our way to its solution?

I reply, from the scientific stand-point. All such political questions as those of the tariff and the currency are, in their nature, scientific questions. They are not matters of sentiment or feeling, which can be decided by popular vote, but questions of fact, as effected by the mutual action and interaction of a complicated series of causes. The only way to get at the truth is to analyze these causes into their component elements, and see in what manner each acts by itself, and how that action is modified by the presence of the others: in other words, we must do what Galileo and Newton did to arrive at the truths of nature. With this object in view, whatever our views of culture, we may let science, scientific method, and the scientific spirit, be the fundamental object in every scheme of a liberal education.

S. NEWCOMB.

ECCENTRIC FIGURES FROM SOUTHERN MOUNDS.

IN a recent publication,[1] I have described a number of relics from the mounds, that present many new and remarkable features. The most important of these were two engraved shell disks, the designs upon which presented very marked variations from the work usually attributed to the mound-builders. Tracings of these are given in figs. 1 and 2.

Both specimens were found associated with characteristic mound relics, and had undoubtedly been deposited with the dead by the builders of the mounds. The question of origin was left for settlement to the light of future discoveries; the only conclusion reached being, that, while the ornaments had a northern character, the designs engraved upon them were decidedly southern, that is to say, Mexican or Central-American. Recently some important additions have been made to this class of works, and a flood of light has been thrown upon the subject.

Explorations in Georgia, conducted by Dr. Thomas for the bureau of ethnology, have brought to light two more shell gorgets bearing engraved designs of human figures. Outlines of these are given in figs. 3 and 4.

[1] Proc. anthrop. soc. Washington, vol. ii.

In case there should be any question as to the place of these objects among true mound relics, I present the following facts furnished by Dr. Thomas from the observations of his assistant, Mr. Rogan. The mound from which

FIG. 1. — Shell gorget from a mound in Missouri.

they were obtained belongs to the celebrated Etowah group at Cartersville, Ga., and is the one marked 'C' in plate I. of Jones's 'Antiquities of the southern Indians.' The burials were in a layer of dark, rich loam, and all in well-constructed stone cysts of the usual shape. They were not all at the same depth, but were near the base of the mound, and in every case beneath undisturbed strata of loam, sand, and hard-beaten clay. One of the engraved shells and three copper plates, one of which is given in fig. 5, were found in one grave. They were deposited with a very large skeleton, which had been wrapped in cloth and matting.

A comparison of this pair with the examples from Missouri and Tennessee develops many important points of resemblance. The designs are clearly the work of, or at least have their origin with, the same people, and that people in all probability a Mexican people. This result is, however, not satisfactory, and other evidence is demanded. This is fortunately at hand. From the same mound with the articles of shell a number of copper objects

FIG. 3. — Shell gorget from a mound in Georgia.

were obtained. These contain *repoussé* figures corresponding closely with those engraved on shell. They are made from thin, well-polished sheets of copper of uniform thickness, some of which are a foot in width and twen-

FIG. 2. — Shell gorget from a mound in Tennessee.

ty inches in length. The figures have been stamped in high relief, and the outlines and perforate areas cut with mechanical precision. One of these curious images is shown in outline in fig. 5.

These objects are much corroded, and bear evidence of age corresponding to that of the other relics with which they were buried.

Another is almost a duplicate of this, while two others represent eagles. Very similar to the latter is a copper eagle, made also of sheet-copper, obtained by Major Powell from a mound in Illinois. A tracing of this is given in fig. 6.

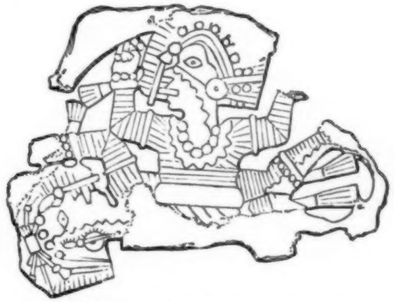


FIG. 4. — Shell gorget from a mound in Georgia.

With these links added to our chain, we are able, not only to say that all of these objects are identical in time and origin, but to say, with a fair degree of confidence, what is the

time and what the origin. The use of sheet-copper, manufactured and manipulated with mechanical precision, will to most minds be sufficient evidence of European agency and post-Columbian time.

This view is enforced by the presence of articles of brass and iron in the mound with one of the shell objects.

Besides this, a study of the designs themselves develops some interesting facts. Four of the designs presented, two on copper and two on shell, represent compound creatures, part bird and part man. This is a characteristic American conception, but in the execution of details there are features very suggestive of an oriental origin. The wings are, for instance, attached to the shoulder-blades behind, the arms being also present, and expand symmetrically to the right and left, resembling medieval angels more closely than Mexican deities. We notice, also, in the delineation of the eagle, a decidedly heraldic character, a symmetrical extension of the wings, legs, and talons highly suggestive of some imperial coat of arms.

In all their leading features the designs themselves are suggestive of Mexican or Central-American work; and, if actually derived from some of the highly cultured nations of

FIG. 5.—Copper image from a mound in Georgia.

the south, it is not impossible that this derivation was through aboriginal agencies: but some of the examples in shell and copper shown in the accompanying figures bear the ear-marks of transatlantic workmen; and I believe it quite probable that they are southern works copied in favorite American mate-

FIG. 6.—Copper eagle from a mound in Illinois.

rials by the avaricious Spanish conquerors, and subsequently used in trade with all the tribes of the Gulf states. This is well known to have been a usual practice with our early traders.

If in the end it should turn out that these remarkable objects are the unaided work of the mound-builders, we shall be compelled to recognize their standing in the manipulation of metal, and in the art of design generally, as unsurpassed by any other native American people. W. H. HOLMES.

ADAPTABILITY OF THE PRAIRIES FOR ARTIFICIAL FORESTRY.

VARIOUS views have been entertained in relation to the treeless condition of the prairies of the interior region of the United States, some of which are rational, some partially so, and others positively erroneous. The opinion has been popularly held, that the prairies were originally covered with forests, as the region to the eastward of them was when it was first known to white men, and that from some unexplained cause these forests were destroyed. Those who entertain this view are disposed to discuss speculatively the origin of the prairies, and practically the means of reforesting them. These are views of men who lay no claim to scientific knowledge; but certain persons, even of scientific pretensions, have claimed that the character of the soil of the prairies is such,

that, although herbaceous plants may grow abundantly upon it, forest-trees cannot thrive. Others, again, suppose that the absence of trees upon the prairies is due to climatic causes, and that the growth of trees upon them by artificial planting will therefore always be precarious or impracticable. A large number of men, with no theory to support, who have made their homes in the great prairie region, have demonstrated by actual experiment that forest-trees will grow thriftily and to full maturity upon its soil.

It is my present purpose to speak of this success, and of the indication which it gives that the great prairie region of the United States may be made to produce the wood for all the needed fuel of the inhabitants, and also for other economic uses. Before doing so, however, it is desirable to describe that region briefly, as it existed when it was first occupied by white men, and to indicate in a general way its limits and its relation to adjacent regions.

It is difficult to define the boundaries of the prairie region as it existed then: first, because it merged, on the one hand, into the woodland regions, and, on the other, into the great arid plains of the west; second, its original characteristic features have been so changed by cultivation, its occupancy by homesteads and villages, and by the increasing presence of trees of both natural growth and artificial planting, that one now rarely gets sight of typical prairies as they existed over so large a region only a few years ago.

In the middle and Gulf states there were originally numerous treeless areas, which were, properly speaking, prairies; but to these I do not now refer. It is sufficient for my present purpose to say that the states of Illinois and Iowa lie in the heart of the region I shall discuss, and that it also embraces large adjacent parts of Wisconsin, Minnesota, Dakota, Nebraska, Kansas, and Missouri.

Although this region occupies a central position upon the continent, its average elevation is not great, a part of it being less than five hundred feet above the level of the sea. The general surface has an approximately level aspect; but it is often undulatory, and sometimes cut by deep valleys. It is traversed by two great rivers, the Mississippi and Missouri, and also by many of their tributaries. The valleys of these streams are cut down somewhat abruptly from the general level, to depths varying from a dozen feet to two or three hundred feet. The streams are bordered by level 'bottom-lands,' varying in breadth from a few rods to several miles.

These bottom-lands and the adjacent valley-sides, together with the contiguous ravine-broken land, contained all, or nearly all, the forest-trees which grew in that great region when white men first knew it; and even these surfaces were then largely destitute of trees. All the broad intervening spaces were covered with a dense growth of grass, mingled only with other herbaceous plants. So small was the aggregate of the timbered as compared with the grass-covered surfaces, that, from a long and early acquaintance with it, I estimate the former to have been not more than five per cent of the whole. In many parts of the region it was certainly less than this.

The early settlers found the Indians in the habit of burning the prairies annually; and they seemed to have practised that habit from time, to them, immemorial. The grass of this great region was largely burnt off every year, either by accident or design; so that from October until May the settlers were seldom out of sight of the lurid light of the burning grass by night, or the towering volumes of smoke by day. The next spring brought an equally abundant growth of grass from the unharmed roots, to fall, in turn, a prey to the devouring flames.

Although that condition of things prevailed within the memory of thousands of persons now living, the present prevalence of artificial groves, and the rapid natural encroachment of trees upon the before treeless surfaces, which followed the discontinuance of the annual fires, have nearly destroyed all the distinguishing characteristics of a prairie region. So rapidly is this change now taking place, that the next generation of those who are to occupy it will probably know of its original prairie character only from tradition or history.

The prairie region in question lies almost wholly within that over which the great northern drift is distributed; and its soil and subsoil are largely made up of the drift material, together with the silt deposit to which the name of 'loess' is now generally applied by geologists. The soil is therefore quite uniform in character over large portions of the region, and yet there is a good degree of variation in different localities. It is generally a rich, deep, dark loam, often without a stone or pebble in sight for many miles. But sometimes drift pebbles and bowlders are scattered plentifully upon the surface; and, in the valley-sides, escarpments of the underlying stratified rocks often appear.

To the westward of the Missouri River the prairies pass gradually into the great plains; and these continue westward to the base of the

Rocky Mountains. The general surface of the plains is similar to that of the prairies; and the character of the soil is also similar, except that it has not been so completely leached of its soluble salts, which are known by the popular name of 'alkali.' There is, in fact, no line of demarkation between the prairies and plains except a climatic one, and there is no other reason for giving them each a different designation than that which has resulted from climatic causes; that is, westward from the Missouri River there is such a gradual diminution of the annual rainfall, that in western Kansas and Nebraska it is insufficient for the purposes of agriculture, while in the eastern part of those states respectively it is ample. In a general way, the line between the arid and humid regions may be said to pass northward medially through the two states just named, swerving somewhat to the westward as it passes through Dakota Territory to the British line.

The trees which grew originally within the great prairie region were, with few exceptions, of the same kinds that grew in the wooded regions to the eastward of it: the more important of the missing kinds being the beech, chestnut, tulip-tree, and the common locust-tree. The more common kinds of trees which grew there were oaks (four kinds), hickory (three kinds), maple (two kinds), elm, cottonwood, black walnut, and linden. Among those which were less common were ash, honey-locust, sycamore, white walnut, mulberry, hackberry, Kentucky coffee-bean, and pecan. Besides these, a few pines and cedars grew upon the rocky cliffs of the valley-sides, and a few other trees were also scattered through the region; but the conifers, as compared with angiospermous trees were rare and of little importance. I use here only the common names of the trees, as given in Gray's 'Manual of botany.'

Traversing the prairie region from east to west and from south to north, it has been found that certain of the kinds of trees above named did not grow so far westward and northward, respectively, as others did. As regards the northern limitation of some, it was probably due mainly to temperature, and the western limitation of others was perhaps due, in part, to approaching aridity; but I think that to about the 98th meridian it was due to the only partially accomplished natural distribution of forest-trees from the eastward, which began at the close of the second glacial epoch. The first of the suggested causes of limitation has an important bearing upon the proper selection of trees for artificial planting in the northern portion of the prairie region. For example: while we may regard the oaks, maples, elm, cottonwood, linden, and others as practically without northern limit in the region under discussion, there are others, but fortunately they are mostly of less comparative value, which have their northern limit within this region. Among the latter may be mentioned the mulberry, honey-locust, Kentucky coffee-bean, and pecan. The hickories and black walnut were plentiful in the immediate region of the Mississippi and eastward, when the country was first known; and those trees seem to be the natural associates of the oaks.

Now, there are two general physical conditions which are inimical to forest-growth; and, wherever either of them is fully established, forests cannot exist. One of these conditions is an arctic climate, whether produced by high latitude or high elevation above the sea: and the other is an arid climate, or one where the annual rainfall is insufficient for the purposes of agriculture. I hold, that, in all regions of the earth which are not affected by either of these great climatic conditions, the foresting and reforesting of the surface, which is covered by a soil suitable for vegetable growth, is practicable for certain kinds of trees.

Neither of these conditions exists within the great prairie region as I have indicated its boundaries. It should therefore be expected that forest-trees would grow there, even if no experimental proof of the fact had ever been made. As one goes westward from this region, however, he finds the country incapable of supporting a growth of forest-trees for the same reason that it will not support a farm-crop; namely, because of its aridity. Both trees and farm-crops can and do grow successfully upon the prairies, because they have sufficient moisture from rainfall. Also, if one should go northward far enough, he would, of course, come to a limit of the successful growth of trees, and also to a limit to the growth of any farm-crop; but that limit is far beyond the northern boundary of the region here discussed.

The experiments of the dwellers upon the prairies have demonstrated that not only may all the indigenous trees of the adjacent valleys be made to grow on all varieties of its soil, but also that many kinds of eastern and exotic forest-trees, as well as most of the common fruit-trees, will grow there equally well. They have shown that the owner of any productive farm in that great region need not be deterred from planting any of those trees upon it, from any other consideration than he would give to the planting of a farm-crop.

These experiments show that certain kinds

of trees grow from artificial planting much more readily and rapidly than others, the cottonwood exceeding all others in these respects. Next, perhaps, comes the common locust, which, however, was not indigenous within the prairie region; but the cultivation of this valuable tree, which was formerly practised there with great success, was suspended, some twenty years ago, in consequence of the ravages of the 'borer.' Then follow certain trees which I name in the order of the apparent readiness and rapidity of their growth; namely, white maple, elm, black walnut, linden, oaks, and hickories.

The greater readiness and rapidity with which some of the trees named will grow by artificial planting do not imply that they have any greater vitality or permanence after their growth is established than the others: it only implies that they have greater promptness of vitality in establishing their growth. For example: the cottonwood may be grown with almost equal facility from the seed or from cuttings; but the oaks, hickories, and walnuts can be successfully grown in practical forestry only from the seed. Even the transplanting of these trees is not usually successful, but their cultivation from the seed is easy and natural.

While these facts concern the practical cultivator especially, they also have an important bearing upon the question of the original distribution of forests. The experiments referred to also show that not only will certain of the indigenous trees of the prairie region, which preferably grew upon the moist soil of the river-valleys, grow thriftily upon the upland prairie-soil, but that all kinds of the indigenous trees, as well as many others, will also grow thriftily upon all varieties of that soil. It is true that some of the soils — those of the loess of the Mississippi valley, for example — were more ready than others to receive tree-growth by the natural process of distribution; but this does not alter the fact, that all varieties of prairie-soil will receive and support an abundant forest-growth, when easily available artificial conditions are applied, and controllable unfavorable conditions are removed.

I have so far spoken of the facility with which trees will grow upon prairie-soil by artificial planting. I have now to speak of another phase of the subject of the propagation of forest-trees; namely, that of their natural encroachment upon prairie surfaces.

The borders of the primitive prairies, where woodland and prairie joined, were usually occupied by thickets of hazel and other shrubs, mingled with stunted trees. Also, for considerable distances out upon the grassy surface, there were numerous dwarfed stubs of oaks, hickories, and other trees, sometimes putting out small branches, only to be destroyed in a year or two by the fires; sometimes burnt to the ground, but their roots remaining alive, and sending up vigorous shoots next year, only to be burnt off by the next fire which should sweep across the adjacent prairie. The prairie borders were thus kept stationary year after year by the fires. It was a perpetual contest between vigorous and progressive vegetable life and its deadly enemy, with material conquests upon neither side.

As soon as the annual fires were stopped by the increasing inhabitants, which they did as a necessary provision for safety, the natural encroachment of the forests upon the prairie borders went on so vigorously, that it required the preventive means of agricultural occupancy to check it.

There are now many thousands of acres of land in the great prairie region, which are densely covered with a full variety of mature forest-trees, which were parts of grass-covered prairie borders when the country was first settled. In many cases, cultivated farms, which were originally established upon the open prairie borders, are now surrounded by woodland, which has become such by natural means since the fires were prevented. Doubtless, local conditions have varied the rate of encroachment of forest-trees upon the prairie borders; but it is plain that the natural tendency is, and always has been, in that direction. This tendency is, in fact, the leading element in original forest distribution, — a process, which, in the present case, beginning with the close of the second glacial epoch, probably progressed mainly from the eastward and south-eastward. This process of distribution was only partially accomplished in the prairie region when it was first known to white men. No doubt, the uncompleted state of the distribution was primarily due to the want of necessary time for its accomplishment since the distribution began; but it was certainly long held in check by the annual prairie fires.

It is not my present purpose to discuss geological questions with regard to the prairies; but since the remains of trees, which have not unfrequently been exhumed from beneath the surface in that region, have been supposed to afford proof of the former forested condition of the prairies, it is desirable to refer briefly to that subject. It is no doubt true, that the great prairie region was formerly occupied by a forest-

growth, as many other now treeless parts of North America have been, not excepting at least a large part of the present arid region; but those forests existed in other geological epochs, and they have been destroyed by subsequent unfavorable physical changes. The region of the great prairies has also been shorn of its forests once, and perhaps twice, since the tertiary period: that is, in the tertiary period, and even before, an extensive arboreal flora prevailed in North America, which was closely related to that which now exists; but, with the accession of the glacial epoch, the forests of the region here discussed were necessarily wholly destroyed, except, perhaps, along its southern borders.

Accumulating evidence seems to show, that there was an interglacial epoch of temperate climate, during which that great region was again covered with forests, and that these were in turn destroyed by the second glacial epoch. It is the remains of these interglacial forests that have been so frequently found in excavations made in the prairie region, and which have excited so much local interest. Those forests were evidently extensive; but, unlike those now living there, they seem to have consisted largely of conifers. I do not doubt, that, at the close of the second glacial epoch, the present prairie region of the United States was as completely destitute of trees as any of its present prairies were when white men first discovered them. The opinion also seems a reasonable one, that the foresting of the prairies has been slowly in progress, ever since the close of the second glacial epoch, by the process of natural dispersion, and, furthermore, that this dispersion of trees progressed mainly from the south-eastward. Not only were the interglacial forests necessarily destroyed by the icy visitation of the second glacial epoch, but the whole, or nearly the whole, surface was rewrought, and practically a new soil was produced by the glacial action and the subsequent physical conditions.

Such a new soil would naturally be first occupied by herbaceous plants, whose abundant and annually matured seeds are so readily distributed by natural means. So, also, the pioneer occupants of the new land among the trees would doubtless be those whose light and abundant seeds are capable of being distributed by the winds, and whose most congenial habitat is upon the moist grounds which border the streams: such are the cottonwood, willows, and elm, for example. It is especially the first two that are found to be the most advanced of the western arboreal pioneers upon the borders of the great plains, and which were doubtless the pioneers in the primitive foresting of the prairie region. Other trees followed those pioneers more slowly, for their methods of propagation were slower; but still the methods of natural propagation of the majority are sufficiently vigorous to suggest, that, if the prairie fires had never been introduced, the early settlers would have found that great region a forested instead of a prairie one.

How long the battle of the fires against the trees continued is not known; and by what successive steps the latter succeeded in gaining and holding even the small strips of land along the borders of the streams of so wide a region, hundreds of miles from the place of their original departure, it is difficult to say. It is probable that the pioneer trees effected their occupancy there, to a large extent, before the fires prevailed, and that their presence favorably modified the immediate conditions for the occupancy of other trees. The streams also seem to have favored their occupancy, not only by the additional moisture which they gave to the adjacent soil, but by acting as checks to the fires which alternately swept the prairies on each hand, lessening the average frequency of fires upon their bordering bottom-lands by perhaps one-half of what it otherwise would have been.

The subject, as I have attempted to present it, may be summed up briefly as follows: in the natural geographical distribution of faunas and floras, nature necessarily fixes the potential boundary of such distribution at a greater or less distance in advance of the boundary of actual occupancy; and, when these two boundaries come to coincide, there is necessarily an end to distribution. When the prairie region was first known, the potential boundary-line of forest occupation was at least five hundred miles westward from that of full occupancy.

At the close of the glacial epoch the whole of the great prairie region was practically destitute of vegetation, but its new soil was capable of supporting an abundant and varied growth. Herbaceous vegetation first occupied the soil, and trees followed more slowly. The obstacles to the occupancy of the new soil by forest-trees at the close of the glacial epoch were, first, the slowness of the process of natural distribution; second, the pre-occupancy of the soil by herbaceous vegetation, preventing or retarding the effective germination of the seeds of trees; third, the subsequent prevalence of annual fires upon the grassy surfaces, which retarded forest-growth.

The conditions favorable to the natural dis-

tribution of trees in that region were a fruitful and congenial soil and a favorable climate. If the fires had never been introduced, the two first-named obstacles to forest-distribution in the prairie region would probably have been practically overcome by the time when the country was first settled; but, upon their introduction, an equilibrium of the retarding and accelerating forces was established and long continued. With the final cessation of the fires, and with the favoring conditions incident to agricultural occupancy, that equilibrium was destroyed, and the vigorous natural tendency to forest-distribution again asserted itself. It is now in full force except where it is checked by human agency; and it is greatly accelerated where such agency is exerted in its favor. It therefore only remains for the inhabitants of the great prairie region to decide whether their land shall be forested or treeless.

C. A. WHITE.

THE APPLICATION OF PHOTOGRAPHY TO THE PRODUCTION OF NATURAL HISTORY FIGURES.[1]

FROM the accuracy and rapidity of its delineations, photography has proved itself an invaluable aid to science, although in natural history its use has been somewhat limited from the difficulty or impossibility of putting many of the objects in a vertical position. To make photography applicable to all classes of objects, it is simply necessary to have the camera so arranged that it may be placed at any angle from horizontal to vertical. The object to be photographed may then occupy its natural position, whatever that may be. For the last ten years, there has been in constant use, in the anatomical department of Cornell university, an apparatus constructed on this principle. It consists essentially of a camera fastened to a board that may be swung from horizontal to vertical, and clamped firmly at any angle.

With this instrument have been photographed, not only objects ordinarily photographed with a vertical or horizontal camera, but delicate embryo brains and other objects that would collapse if removed from liquid. Living salamanders (Necturi) have been photographed under water, their gills remaining completely outspread.

[1] Papers on this subject were given by the writer at the meeting of the American association for the advancement of science in 1879, and at the meeting of the Society of naturalists of the eastern United States in 1883. The only other persons employing a vertical camera in photography, known to the writer, are Dr. Theo. Deecke of the State lunatic-asylum at Utica, N.Y., and Dr. Dannadieu of Lyons, France. (For the last, see Anthony's *Photographic bulletin*, December, 1883, p. 404.)

A photograph answers the requirements of a scientific figure in but few cases; as the object usually is to bring out with diagrammatic clearness a few details, subordinating or omitting others: hence the photograph is used as the basis of the figure; that is, the object is delineated of the desired size, all the parts being in their proper relative position. From this photographic picture may be traced all the outlines directly upon the drawing-paper; thus avoiding the tedious labor of measurement by

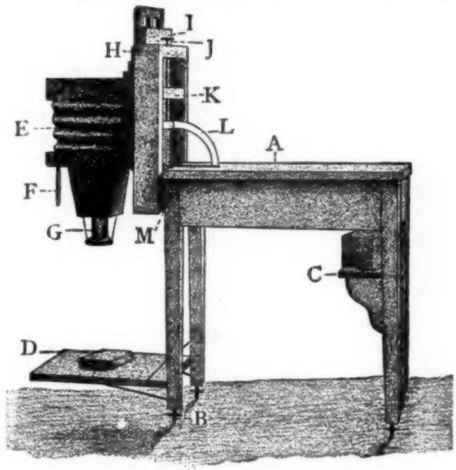


FIG. 1. — Side view of a vertical camera. *A*, the table supporting the camera; *B*, levelling-screws; *C*, shelf for holding a box of sand as counterpoise; *D*, stage upon which the object is placed (it is made parallel with the top of the table); *E*, camera with cone; *F*, slotted brass guide (see fig. 2); *G*, the photographic objective (its cap is made of card-board, and covered with black velveteen; it is held in position by two rubber bands); *H*, frame hinged to the table, and supporting the camera; *I*, movable board to which the camera is clamped; *J*, head of the focusing-screw; *K*, block fastened to the movable board *I*, and containing the nut which receives the focusing-screw; *L*, semicircle by which the frame bearing the camera is set at any angle; *M*, thumb-screw pressing against the semicircle *L*, and serving to fix it at any point.

the artist, and leaving all of his time available for artistic work proper.

While, however, the use of the photograph for outlines diminishes the labor of the artist about one-half, it increases that of the preparator; and herein lies one of its chief merits. The photographs being exact images of the preparations, the tendency will be to make them with greater care and delicacy, and the result will be less imagination and more reality in published scientific figures; and the objects prepared with such care will be preserved for future reference.

In the use of photography for figures, several considerations arise: 1°. The avoidance of distortion; 2°. The adjustment of the camera to

obtain an image of the desired size and focusing; 3°. Lighting and centring the object; 4°. The obtaining of outlines for tracing upon the drawing-paper.

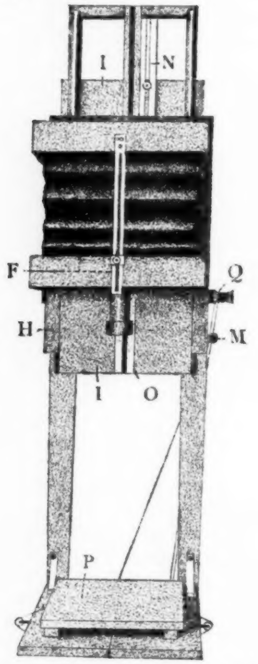


FIG. 2. — Front view of the vertical camera. *F*, slotted brass guide, serving to support the upper part of the camera, and to indicate the enlargement or reduction; *H*, frame hinged to the table; *I*, board moving in the frame *H*, and holding the camera; *N*, iron bars attached to the bed of the camera (upon these presses the thumb-screw from the board *I*); *O*, similar iron bars in the movable board (in the slot works a thumb-screw from the camera; these thumb-screws clamp the camera to the movable board); *P*, object-carrier on casters (this may be moved by the operator by turning the spools *Q*); *Q*, spools for the cords from the object-carrier.

1°. While the camera delineates rapidly, the image is liable to distortion. I believe opticians are agreed, that, in order to obtain correct photographic images, the objective must be properly made, and the plane of the object must be parallel to the plane of the ground glass. Furthermore, as most of the objects in natural history have not plain surfaces, but are situated in several planes at different levels, there will be a liability of distortion from that cause also. This may be rendered practically nothing, however, by using in the objective a diaphragm with a small opening.

2°. By placing the camera on a long table, and a scale of some kind against the wall, the exact position of the ground glass for various sizes may be determined once for all. These positions are noted in some way (on the brass guide, *F*, in the apparatus here figured). Whenever it is desired to photograph an object, natural size, for example, the ground glass is fixed in the proper position indicated on the brass guide (fig. 2, *F*). Then, as the relative position of the objective and the ground glass cannot be varied, it is necessary, in focusing, to move the camera toward or away from the object, or the reverse. In order to do this, the camera is fastened to a board which moves in a frame by means of a screw (figs. 1, 2, *I*, *H*, *J*). Whenever the camera is to be moved considerably, — as to a position for twice natural size from one giving an image of half natural size, — the position of the camera on the board is changed by loosening the two thumb-screws clamping it to the movable board (fig. 2, *N*, *O*). The approximate position for the various sizes being once determined and noted, it is but a moment's work to set the camera for any enlargement or reduction within its range.

3°. The object is placed on the horizontal stage, and so arranged that the lighting will give prominence to the parts to be especially emphasized. For a contrasting background, black velveteen for light, and white paper for dark, objects, have been found excellent. To get the object in the centre of the field of the objective, the stage bearing the object may be movable; so that the operator, while looking at the image on the ground glass, may move the object in any desired direction by turning the spools on which are wound the cords from the movable stage (fig. 2).

4°. If the photographic prints are to be used solely for outlines, the well-known blue prints so much used in engineering and architecture may be made. If, however, light and shade and fine details are to be brought out with great distinctness, either a silver or a platinotype print is preferable. In whatever way the print is made, it is blacked on the back with soft lead-pencil, put over the drawing-paper, and the outlines traced. Instead of making a print from the negative, one may get a tracing directly from it on tracing-paper; and this may, of course, be used in the usual way. Finally, if one possesses a camera, a tracing may be made of the image directly, without the aid of a negative. It is only necessary to substitute a piece of plain glass for the ground glass, and, after spreading upon it some fine tracing-paper, to trace the image. This is especially applicable to the enlargement or reduction of other figures.

SIMON H. GAGE.

THE COLORS OF NATURAL WATERS.

Mr. W. Spring, of the University of Liege, has greatly advanced our knowledge of this subject in a paper in the *Revue scientifique* for Feb. 10, 1883, a translation of which also appeared in the *Popular science monthly* for May. He begins with a careful and critical summary of the views of previous observers, and from these and his own experiments reaches the following important conclusions: 1. Water, in the purest state in which it can be obtained, has a distinct and beautiful blue color, which must be regarded as its essential or proper color, as the color of absolutely pure water; 2. The green, yellow, and brown colors observed in water are due to the reflection of light by matter held in suspension. This suspended foreign matter is very finely divided, and probably is usually in the state of nascent precipitation. It may be liquid or solid, transparent or opaque.

"The important point is, that it be competent to reflect light. Then the light-rays of feebler intensity (violet, blue, green, etc.) suffer extinction, one after another, according to the thickness of the medium, till the yellow rays, the brightest to our eyes, are the last to survive the struggle.

"The obstruction of the light, inducing the yellowish tint, which may be produced by any salt, depends less on the quantity of the salt present than on its being near the stage of precipitation. Small quantities of a feebly soluble salt produce the same effect as large quantities of a more soluble salt. The variety in the colors of natural waters, then, may be thus explained: absolutely pure water, viewed in masses of sufficient thickness, has a beautiful blue color. If it holds in complete solution colorless salts, its color is not changed; but, in proportion as it may contain matter on the verge of precipitation, the light traversing it will be of a yellow or darker color, until a stage is reached when the liquid will let no light through, and becomes opaque or black. The yellow light will combine with the blue light of the water; and thus will be produced greenish-blue, bluish-green, and green tints, according to the strength of the yellow. If the latter is very strong, the dark blue will be wholly smothered, and the water will appear yellow, brown, or of a still darker color."

The less soluble bodies in natural waters — those which may be regarded as frequently in the state of nascent precipitation, and to which the colors are chiefly due — are the carbonates of calcium, and silica, and also, probably, the finest mechanical sediment or clay, which, although not properly soluble, forms an emulsion with water, and affects the light in the same way as an incipient precipitate.

This theory appears to me to be the only one yet advanced affording a consistent explanation of all the phenomena; and my present purpose is to call attention to a general and important fact concerning the color of natural waters (which appears to have been but little noticed or appreciated by scientific observers, and of which I have never seen any explanation), and to show that it harmonizes beautifully with Mr. Spring's theory. Briefly stated, this general fact is as follows: tropical and warm seas are blue, and polar and cold seas are green; i.e., other things being equal, the color of the water is determined by the temperature.

All voyagers in tropical seas must have noticed the magnificent blue color of the water; the color seeming to be purest and most intense under the equator, or where the water is warmest. On passing to higher latitudes and lower temperatures, the color changes to greenish blue, bluish green; and green, although the Gulf Stream and other warm currents carry the tropical color and temperature well up toward the frigid zones, and into the midst of seas whose prevailing tint is deep green. Probably nothing makes the Gulf Stream seem more real, especially to the unscientific observer, than the great contrast in color that is presented within a very short distance, when we cross its northern wall. On one side is the cold, green water of the polar current, and on the other the warm, blue water of the Stream. The difference in color between the Gulf Stream and the surrounding parts of the ocean is noticeable even in the North Atlantic, on the track of the transatlantic steamers; and I have found that this part of the sea is perceptibly greener in winter than in summer.

As already stated, this general difference in color between warm and cold seas, although not explained by Mr. Spring, is a necessary corollary of his theory: for warm water is, for most substances, a more powerful solvent than cold water; and if cold seas are green in consequence of some of the contained salts being imperfectly dissolved, i.e., in a state of nascent precipitation, then an increase of temperature in the water, by augmenting its solvent power, will tend to obliterate the green color, and restore the blue. Again: warm water possesses less adhesion than cold water, which would cause a more rapid deposition of fine clayey matter in warm water than in cold. Hence, if the green color of cold seas is due, not to imperfectly dissolved salts, but to the suspension of fine insoluble clays, forming an emulsion, an increase of the temperature of the water, by causing a more complete deposition of the suspended clayey matter, will also tend to change the color of the water from green to blue.

In short, it follows from this theory, that, other things being equal, the color of natural waters must be a function of the temperature; and this conclusion is sustained by observation. One general exception, however, should be noted; viz., that shallow water near shore is usually green, even in warm seas, on account of the large amount of foreign matter in suspension. This was very noticeable on the coast of Cuba; the sea being of a pure blue color to within a few rods of the beach, and then rapidly changing to green. When viewing the coast from an elevated promontory, these colors were quite distinct to the eye for a distance of one to two miles along the shore.

As affording additional confirmation of the theory, I offer the following notes on the colors of European waters, which were made during the summer of 1883, while travelling from Sicily to Throndhjem in Norway. I was not able to make corresponding observations of the temperature of the water; but this may be approximately inferred, in most cases, from the latitude and season.

April 14 to 16. — The Mediterranean, between Stromboli and Sicily, is a decided blue, but not so deep and brilliant as the blue of the Gulf Stream and West-Indian waters. In the harbors of Messina and Catania the water is a brilliant green, inclining to blue. The color of the sea along the entire east coast of Sicily, from Messina to Syracuse, as viewed from the land, is blue, inclining to green.

April 22 to 26. — The water about the Lipari Islands, and between them and Messina, is of a dark, intense blue.

April 27. — The Bay of Naples is dark green, with scarcely a trace of blue.

April 28. — The sea about Salerno, and between that and Amalfi, as seen from the shore, is a beautiful blue-green, but sometimes pure bright green, and again, when deep, inclining strongly to blue.

May 1. — The Bay of Naples, between Naples and Ischia, is a deep green, without a trace of blue.

May 4. — The sea all about Capri and Sorrento is a pure, deep, and beautiful blue. These shores are vertical walls of rock, which afford very little sediment to the water. Later in the summer, as many observers testify, the Bay of Naples is blue throughout.

June 1 to 4. — The waters of the Italian lakes — Como, Lugano, and Maggiore — are a beautiful and distinct green. John Ball, F.R.S., in his 'Alpine guide,' states that the southern end of Lake Maggiore is blue. I found it almost as green as the northern end: but it is probably blue in mid-summer; and, if so, it must be regarded as a striking confirmation of the theory.

June and July. — The Swiss lakes are generally bright green and somewhat opaque. Lake Geneva, however, as is well known, is a lovely blue, resembling the sea about Sicily; but toward the upper end it seemed to be slightly greenish. The other Swiss lakes derive their waters from regions that are largely composed of limestone, and hence these waters are saturated with carbonate of calcium. But the Rhone, which is the principal tributary of Lake Geneva, drains a region of metamorphic rocks containing but little limestone.

Aug. 2. — The Baltic, between Stralsund and Copenhagen, is dull green.

Aug. 3 to 4. — The color of the Cattegat is dull green, without a trace of blue.

Aug. 7 to 23. — Between Christiansand and Throndhjem the open sea and the lower parts of the fiords have a deep, dark green color, with scarcely ever a suspicion of blue. As we ascend the fiords, the color becomes a lighter green, and more vivid and opaque, in proportion as the water becomes fresher. The heads of the fiords and the adjacent lakes are usually indistinguishable in color from the Swiss lakes; but the beautiful Ringedalsvand, lying between the head of the Hardanger Fiord and the celebrated Ringedalsfos, at an altitude of fifteen hundred feet, is a notable exception. This lake is deep blue except near the shore, where it is greenish blue; and the streams flowing into it, as well as that flowing out, are nearly pure blue. The rule that cold water is green does not hold in this case, but the exception is readily explained as due to the unusual purity of the water. The lake is bounded on all sides by cliffs of granitoid gneiss, and where there is a talus at the bottom it is usually destitute of soil. Above the cliffs are immense fields of snow, whence the water of the lake is derived. None of the tributary streams flow from glaciers; but they are all limpid snow-water flowing down over hard rocks, which are alike destitute of soil or material which could be carried away in suspension in the water, and of limestone or other materials capable of being dissolved in the water. It would probably be difficult to find any considerable body of natural water which is more nearly a pure distilled water than this. And we may fairly say, that, on account of its remarkable purity, it is blue, in spite of its low temperature.

W. O. CROSBY.

THE GEODETIC WORK OF THE HAYDEN AND WHEELER SURVEYS.

THE publication of the final results of the triangulation of these surveys furnishes the material for a direct comparison between them, inasmuch as the two surveys covered in duplicate large areas of country. Fully one-half the mountain area of Colorado, and a large extent of country in north-eastern Utah and south-eastern Idaho, have thus been surveyed in duplicate. An examination shows, that in the former area no fewer than twelve points have been occupied in common as geodetic stations, and their positions published by each organization. The following are the points in question, with the latitudes and longitudes as given by each survey, the determinations of the Hayden survey preceding in each case. The names in parentheses are those given to the points by the Wheeler survey.

STATIONS.	Latitude.	Longitude.
Blanca	37° 34′ 43″.5	105° 28′ 55″.4
	37 34 37 .0	105 28 57 .0
Pagosa	37 26 43 .1	107 3 47 .2
	37 26 37 .6	107 3 50 .0
Rio Grande Pyramid (Simpson)	37 40 52 .2	107 23 19 .2
	37 40 46 .0	107 23 22 .0
Uncompahgre	38 4 23 .0	107 27 30 .1
	38 4 18 .0	107 27 33 .0
Ouray (Hunts)	38 25 26 .1	106 13 15 .7
	38 25 20 .0	106 13 18 .0
Agency Knob	38 16 30 .7	106 51 47 .6
	38 16 24 .0	106 51 54 .0
Wilson (Glacier)	37 50 26 .4	107 59 16 .9
	37 50 21 .0	107 59 20 .0
Leon	39 4 51 .0	107 50 24 .7
	39 4 45 .0	107 50 27 .0
South River (Macomb)	37 34 31 .7	106 58 40 .2
	37 34 25 .0	106 58 43 .0
Summit (Meigs)	37 21 7 .3	106 41 35 .4
	37 21 1 .0	106 41 39 .0
Sneffels (Blaine)	38 0 19 .0	107 47 18 .7
	38 0 14 .0	107 47 22 .0
Banded	37 6 21 .6	106 37 24 .5
	37 6 16 .0	106 37 27 .0

The following are the discrepancies between the above results: —

STATIONS.	DISCREPANCIES.	
	Latitude.	Longitude.
Blanca	6″.5	1″.6
Pagosa	6 .1	2 .8
Rio Grande Pyramid	6 .2	2 .8
Uncompahgre	5 .0	2 .9
Ouray	6 .1	2 .3
Agency Knob	6 .7	6 .4
Wilson	5 .4	3 .1
Leon	6 .0	2 .3
South River	6 .7	2 .8
Summit	6 .3	3 .6
Sneffels	5 .0	3 .3
Banded	5 .6	2 .5

It will be seen that the discrepancies in latitude are quite constant, ranging from 5″.0 to 6″.7, the Hayden latitudes being in every case the greater; and that the discrepancies in longitude are almost equally constant, ranging, with the exception of one case, from 1″.6 to 3″.6, the Hayden longitudes being in every case the smaller. The comparatively large discrepancy in the longitude of Agency Knob is explainable by the fact, that, from most points of view, this station presents an ill-defined summit. The constancy of these discrepancies points to the fact, that they are in the main due to station-error, as is unquestionably the case. The Hayden work was based on Denver as determined astronomically by the U. S. coast and geodetic survey, while the Wheeler work depends upon Colorado Springs as determined by the Wheeler survey. The relative station-error of these two places has not been determined directly, but cannot fail to be considerable, owing to the difference in their surroundings.

Assuming that the difference in station-error between Denver and Colorado Springs is, roughly speaking, equal to the average difference between the Hayden and Wheeler work (leaving out Agency Knob), — i.e., 5″.9 in latitude, and 2″.7 in longitude, — and correcting one of the two above sets of results therefor, the discrepancies between them become as follows: —

STATIONS.	DISCREPANCIES.	
	Latitude.	Longitude.
Blanca	0″.6	1″.1
Pagosa	0 .2	0 .1
Rio Grande Pyramid	0 .3	0 .1
Uncompahgre	0 .9	0 .2
Ouray	0 .2	0 .4
Agency Knob	0 .8	3 .7
Wilson	0 .5	0 .4
Leon	0 .1	0 .4
South River	0 .8	0 .1
Summit	0 .4	0 .9
Sneffels	0 .9	0 .6
Banded	0 .3	0 .2

The mean of these differences in latitude is but 0″.55, and in longitude, with the exception of Agency Knob, but 0″.41.

The area surveyed in duplicate north of the Union Pacific railroad in north-eastern Utah and south-eastern Idaho does not show quite so close accordance in results. The Hayden work here depends upon the astronomical determination of Salt Lake City by the U. S. coast and geodetic survey, and is checked upon the determination of Ogden by Wheeler's survey, upon which the Wheeler work rests. This check shows little or no difference in station-error between the two astronomical stations. The following are the positions of five points

occupied in common by the two surveys, as given by Hayden and Wheeler, the determinations of the former preceding : —

Stations.	Latitude.	Longitude.
Putnam, Idaho	42° 57′ 10″.6 42 58 8 .0	112° 10′ 9″.4 112 10 10 .0
Preuss (Meade), Idaho	42 29 42 .6 42 29 41 .0	111 15 11 .0 111 15 11 .0
Soda (Sherman), Idaho	42 27 53 .7 42 27 52 .0	111 33 11 .4 111 33 11 .0
Caribou (Pisgah), Idaho	43 5 36 .2 43 5 34 .0	111 18 56 .7 111 18 58 .0
Willard (North Ogden), Utah	41 21 44 .9 41 21 45 .0	111 57 53 .1 111 57 53 .0

The following are the differences between the two sets of results : —

Stations.	Differences.	
	Latitude.	Longitude.
Putnam	2″.6	0″.6
Preuss	1 .6	0 .0
Soda	1 .7	0 .4
Caribou	2 .2	1 .3
Willard	0 .1	0 .1

The average differences are respectively 1″.6 and 0″.5.

It is to be regretted that the distances between these points, as determined by the Wheeler survey, are not available, in order that a more direct comparison might be made.

It should be understood that the object of each of these systems of triangulation was simply and solely to furnish adequate control for topographic work, to be published on a scale of four miles to an inch, or about $\frac{1}{250000}$. A greater degree of accuracy than was required for this purpose was not contemplated. In all cases natural points were used as signals until the stations were occupied, when rude cairns of stone, six to eight feet in height, were erected, and used thereafter as signals. The Hayden work was carried on with an eight-inch theodolite, reading to 10″; and the work was adjusted by a graphic method, with foresights only. The area triangulated by this survey aggregated nearly a hundred and twenty thousand square miles; which work, besides the measurement and expansion of four base-lines, was done by one party in six field-seasons, each of four months' duration. As a rule, all the work upon a station was completed in a few hours. The general character of the Wheeler work was very similar to that of the Hayden survey, except that the adjustments were made by least squares.

HENRY GANNETT.

THE DEEP-SEA DREDGING APPARATUS OF THE TALISMAN.[1]

THE first French deep-sea exploring expedition was made in 1880 by the Travailleur, in the Bay of Biscay. The following year the Travailleur was again put at the disposal of the commission over which Mr. Milne-Edwards presided; and the party traversed the Bay of Biscay, visited the coast of Portugal, passed the Strait of Gibraltar, and explored a large part of the Mediterranean. In 1882 the same vessel undertook a third expedition into the Atlantic Ocean, and proceeded as far as the Canary Islands. But the Travailleur, being a despatch-boat for harbor use, did not possess the requirements for making long voyages; and accordingly the Talisman, a cruiser, was equipped for a new dredging expedition, and left the port of Rochefort on the 1st of June, 1883, with Mr. Milne-Edwards and the commission appointed by the minister of public instruction on board. The Talisman explored the coasts of Portugal and Morocco, visited the Canaries and Cape Verde, traversed the Sargasso

FIG. 1. — Course of the Talisman.

Sea, and, after remaining some time at the Azores, returned and explored the Bay of Biscay (fig. 1).

On the bridge of the Talisman there had been

[1] Condensed from an account in *La Nature*. By H. FILHOL.

arranged a sounding-machine, worked by engines, and the electric-light apparatus. From the foremast

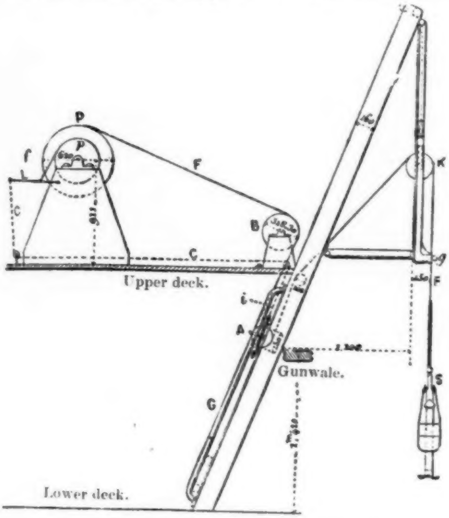


Fig. 2. — Plan of the sounding-apparatus.

a beam or crane projects beyond the vessel to carry the dredges or trawls. The sounding-apparatus used was devised by Mr. Thibaudier, and automatically registers the number of metres of cable run out, and stops when the sounding-cup reaches the bottom. Fig. 3 represents a part of this apparatus, and fig. 2 the plan of another part, in order the better to show its action. It is composed of a reel (*P*, fig. 2) on which were rolled ten thousand metres of steel wire one millimetre in diameter. From the reel the wire passes round a wheel, *B*, exactly one metre in circumference: from there it runs down to a wooden slide, *A*, moving along the sheers, mounts to a fixed block, *K*, and reaches the sounding-cup *S* after having crossed a guide, *g*. The wheel *B* carries at its axis an endless screw, which sets in motion two toothed wheels, showing the number of turns made. One registers the units, the other the hundreds (fig. 4). The latter is graduated to measure ten thousand metres. Each turn of the wheel *B* corresponds to one metre, the number indicated by the register representing the depth. On the axis of the reel there is a brake. Another brake, *f* (fig. 2), is worked by a lever, *L*, at the extremity of which there is a cord, *C*, which is fastened to the slide *A*. When the vessel rolls, and the tension of the steel wire supporting the sounding-cup increases or diminishes, the slide is slightly lowered or raised along the sheers: in this movement it acts more or less on the brake, and consequently regulates the rapidity of unrolling. When the sounding-cup touches the bottom, the running-out of the wire, suddenly relieved of its weights (which sometimes amount to seventy kilograms), instantly stops.

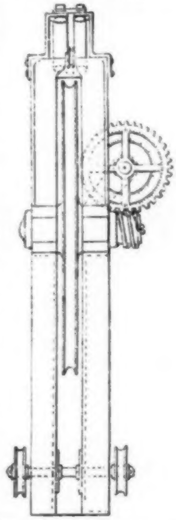


Fig. 4. — Register of sounding-line paid out.

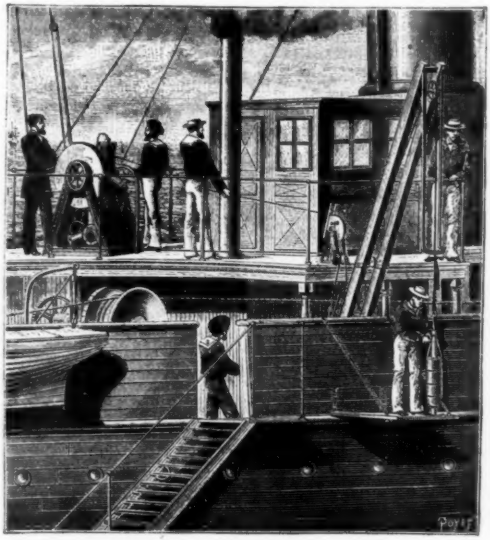


Fig. 3. — General view of the sounding apparatus.

The action of this apparatus is easily understood. The sounding-cup and its weights are arranged within the ship. Some one is stationed at the lever *L* (fig. 2). The register is put at zero. Every thing being thus arranged, the brake is freed, and the unrolling continues until the bottom is reached. While sounding, the vessel is kept motionless by means of its engine, that the wire may remain as vertical as possible. When the bottom is reached, one has only to read the indication on the register to know the depth. Connected with the axis of the drum is a little engine to raise the sounding-cup when relieved of its weights.

The sounding-cup (fig. 5) consists of a long and stout iron tube having two chambers, placed one on the other, and perfectly independent of each other. In the upper compartment there is a metallic rod,

at the upper end of which is a ring, and to this is attached the sounding-line. When this is pulled, the rod moves up slightly, a stop controlling its course at a certain point. On the opposite sides of this rod are hooks. To accelerate the descent of the sounder, it is loaded with large cast-iron disks. On the outer surface of these disks are two longitudinal grooves through which pass wires from a ring under the lowest disk, ending in two rings resting on hooks just below the upper end of the sounding-rod. When the lead reaches the bottom, and the pull on the sounding-wire ceases, the rod to which the wire is attached falls in the upper compartment of the sounding-tube, releasing the rings from the hooks, and allowing the iron disks to slide off. Relieved of the extra weight, the lead is easily raised. The lower end of the tube is supplied with valves, which are closed by the falling of the iron disks, and enclose any loose matter on the bottom, the action being assisted by a coating of tallow.

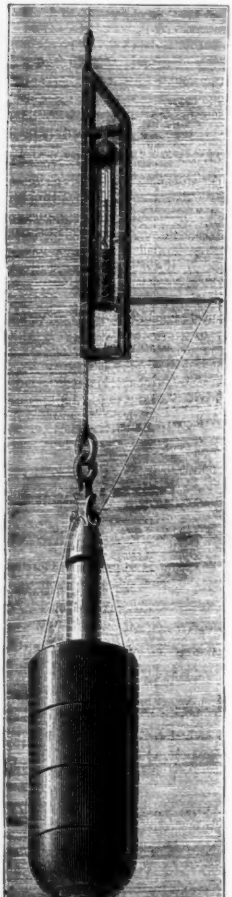


FIG. 5. — Sounding-cup and thermometer.

The thermometers used to determine the temperature of the water at great depths often have to sustain a pressure greater than three hundred atmospheres; that is, more than thirty tons to a square decimetre. Two are used, incased in very thick glass walls. When the lead reaches the bottom, and the extra weights become detached, the catch holding the thermometer-case is released by the breaking of the cord attached to the long lever shown in the upper part of fig. 5, and the thermometers are inverted. The mercury-column is then broken at a point above the bulb where the tube is narrow, and the mercury in the tube falls to the lower end, which is graduated.

On the Travailleur a hemp rope was used for the

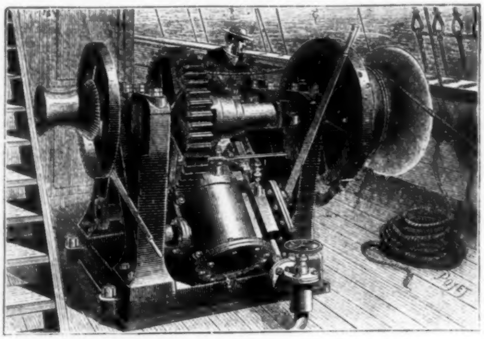


FIG. 6. — Windlass for raising the dredges and trawls.

dredges, of which we give a cut showing its actual size (fig. 8, no. 1), which was not only cumbersome, but had little strength, breaking under a load heavier than two thousand kilograms. On the Talisman a wire rope (fig. 8, no. 2) was employed, composed of six strands of seven steel wires each, twisted around a hempen core. Notwithstanding that it was formed of forty-two wires, its diameter was only one centimetre. Upon trial it bore a weight of forty-five hundred kilograms without breaking.

The collecting-apparatus used on board the Talisman consisted of dredges and trawls. The dredges have an iron frame of rectangular shape, to which is fitted a sack formed of closely-woven cords. The sides of the frame, before reaching the bottom, stand up at right angles, and are provided with scrapers cut and inserted at such an angle that they not only

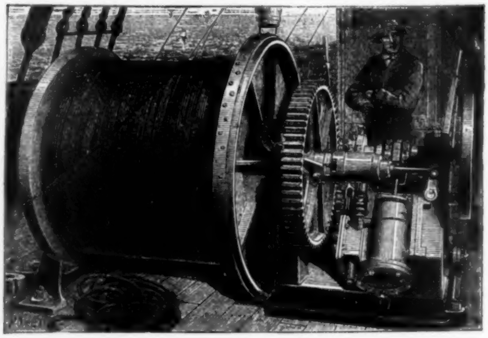


FIG. 7. — Reel for wire rope.

detach clinging objects, but gather the very smallest specimens on the bottom. In speaking of the dredge of Dr. Ball, which for more than ten years (1838–48)

has been in the employ of the English, Wyville Thomson said, that he one day saw the inventor scattering on the floor pieces of money, and raising them again with the greatest ease by means of the

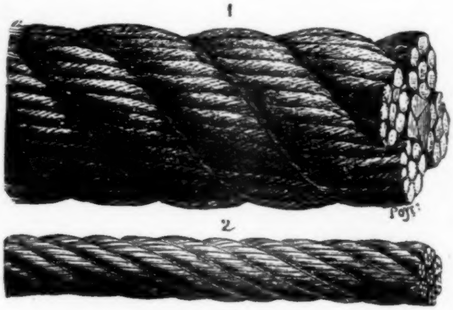


Fig. 8.—Old (1) and new (2) dredging-lines, natural size.

instrument he had contrived. This shows the important use of the teeth with which the sides of the frame are furnished.

To protect the net, which would be torn to shreds by the rocks as it is drawn along, it is enclosed either in another net of iron links, or in a sail-cloth or leather bag. Its lower end acts as a kind of clog, being so arranged that objects, once having entered, cannot escape. The front part of the dredge is sometimes furnished with a rake, to turn the mud or sand of the bottom, and thus to liberate the animals found there. During the explorations of the Travailleur, dredges were sometimes used which, by a special mechanism, descend, closed, to the bottom, and open only when they reach it. But, whatever the plan of the dredge, the results are not valuable; for these machines are almost immediately filled with sand or mud, which, on account of the sail-cloth or leather bag, cannot be released. Generally, when a dredge is raised, a sackful of sediment is all that is brought on board. They are, besides, very inconvenient.

During one of the cruises of the Porcupine, Wyville Thomson noticed, that, while the interior of the dredge enclosed very few interesting specimens, a number of echinoderms, corals, and sponges, caught on the outside of the sack, and sometimes even on the upper part of the chain of the dredge, came to the surface. "This suggested," said he, "many expedients; and finally Capt. Calver sent down half a dozen of the 'swabs' used for washing the decks, attached to the dredge. The result was marvellous. The tangled hemp brought up every thing rough and movable which came in its way, and swept the bottom as it might have swept the deck. Capt. Calver's invention initated a new era in deep-sea dredging." It is certain that the use of tangles gives good results; but they, too, are very inconvenient, as Wyville Thomson was forced to acknowledge.

"The tangles," he says, some pages beyond the passage quoted above, "certainly make a sad mess of the specimens; and the first feeling is one of woe, as we undertake the almost hopeless task of clipping out with a pair of short nail-scissors the mangled remains of sea-pens, the legs of rare crabs, and the dismembered disks and separated arms of delicate crinoids and ophiurids. We must console ourselves with the comparatively few things which come up entire, sticking to the outer fibres, and with the reflection, that, had we not used this somewhat ruthless means of capture, the mutilated specimens would have remained unknown to us at the bottom of the sea." The description is exact; but one must examine the condition of the larger part of the specimens brought up by the tangles, to understand the despair of the naturalists in their search among inextricable confusion of threads, and remains of rare, often unknown, animals. We thus see the necessity of some better method of collecting and bringing up the animals.

During the campaign with the Blake, in the Gulf of Mexico, Mr. Agassiz used trawls, a kind of large net common on our coasts among fishermen, and obtained good results. On board the Talisman, trawls of the same kind, with an opening two or three metres in extent, were employed. The dredges are very rarely used, these being reserved for the exploration of rocky bottoms, where the sharp edges would cut the net into pieces. In fig. 10 is shown one of the trawls used on the Talisman. By an examination of this cut, one can understand the arrangement of the net, which is such, that, on whatever side the machine reaches the bottom, it is always drawn to some purpose. There are two pockets, one inside the other. At the end of the outer one a large cast-iron ball is tied, while the inner pocket opens at its lower end, preventing objects which have entered from getting free again. During the course of the cruise, Commandant Parfait had one of the tangles

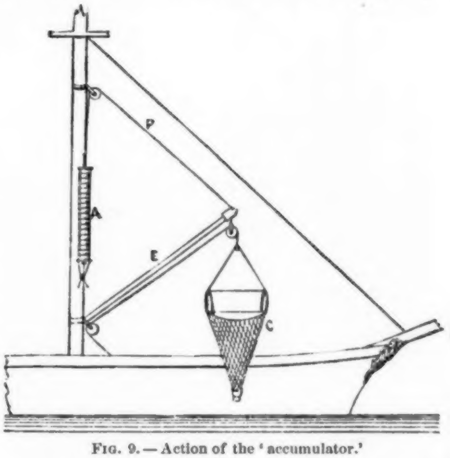


Fig. 9.—Action of the 'accumulator.'

placed at the very bottom of the trawl, with remarkable results. The success was due to the fact that a crowd of all the little animals, crustaceans, mollusks, and ophiurans, which, drawn in with the water into

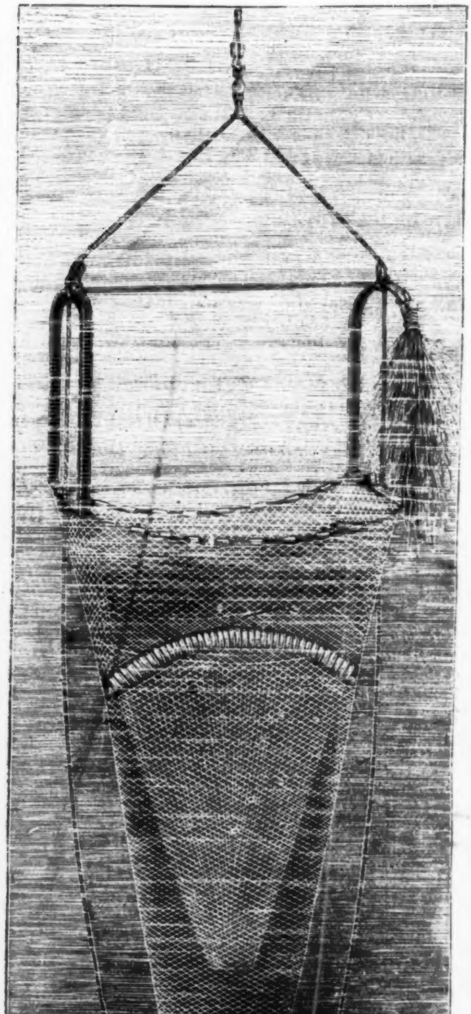


FIG. 10.—The trawl.

the interior of the trawl, would have passed through the meshes of the net, were caught by the long threads of the tangles.

That the strain on the drag-line may be eased, a wire rope (*P*, fig. 9) is made fast to the end of the beam, and, after passing over a block, is connected with a spring balance or 'accumulator,' *A*, made of disks of rubber, and attached to the mast.

The size of the trawl used depends upon the depth to be reached and upon the weather. As a general rule, it may be said that in good weather a trawl of three metres length is used to explore a depth of thirty-six hundred metres. Beyond this depth, a three-metre trawl cannot be used. Lower than three thousand metres, the additional burden is a hundred and eighty-eight kilograms.

When every thing is ready for the lowering of the trawl, the machines are freed, and at first the net is allowed to fall by its own weight and that of the cable which holds it; but after a little time the rapidity becomes too great, and must be regulated by the brakes. During the descent, the ship is held with the wind at the stern, or at least on the side, with its fore and mizen sail set. It must have a speed of at least two knots; and if with the wind alone it cannot make so much, its rate must be increased by steaming. Commandant Parfait discovered that this speed of two or three knots was absolutely necessary, if the cable were to be always taut. If this tension was not maintained, the cable descended more quickly than the trawl, rolled itself up on the bottom, and the net dropped on the bundle thus formed. In this case the cable became tangled, and kinks were formed in great numbers throughout its length. A register on the windlass (fig. 6), around which the cable passes before running into the water, indicates the moment when the net should reach the bottom. When this is reached, the full force of the brakes is applied, and the cable firmly held in place.

To insure the drawing of the trawl along the bottom, it is necessary to unroll a length of the cable greater than the depth of the sea. To a depth of six hundred metres, twice the length is paid out: deeper than this, five or six hundred metres more than sufficient to reach the bottom are run off. While the trawl is dragging, the ship is kept in such a position that it slowly drifts sideways. The time during which the trawl is left on the bottom varies greatly with the depth. In deep dredging it is dragged three-quarters of an hour, at times even several hours. When the trawl rises from the water, it is drawn upon the deck, and placed as seen in fig. 11. In order to obtain the animals enclosed in the thick, sticky mire often brought up in the trawl, the latter must be sifted very carefully. For this purpose a set of metallic frames, placed one upon the other, and raised on balls, is used. By simply giving these frames a backward and forward motion while water is showered into the mud, the smallest animals are obtained without receiving any injury. We have endeavored to show this operation in fig. 11.

Besides the sounding and dredging apparatus,

there were, on the Talisman, special instruments for obtaining water at various depths. It is very important to know the composition of the water in which a certain fauna lives, in what proportion (sometimes under great pressure) gases are dissolved in it, and how much salt it contains. This kind of examination had already engaged the attention of the naturalists on the Challenger and on the Blake. During the cruise in 1882, made by the Travailleur in the Bay of Biscay, on the coasts of Spain and Portugal, and in the Mediterranean, water was drawn from very great depths. For this purpose, water-bottles, consisting of strong metal tubes with valves at both ends to allow of a free circulation, were attached to a sounding-line at distances of five hundred metres apart. The valves were kept open by means of brass levers extending out from the line. When a proper length of line had been run out, a ring was slipped over the line, and allowed to descend, knocking the levers and closing the valves as it went down. With each bottle was attached a self-registering thermometer. The gases contained in the water tend very energetically to escape, pressing strongly on the valves, and closing the mouths more effectively. It has often happened, that, upon opening the valves, a jet of water was thrown from the bottle, like Seltzer.

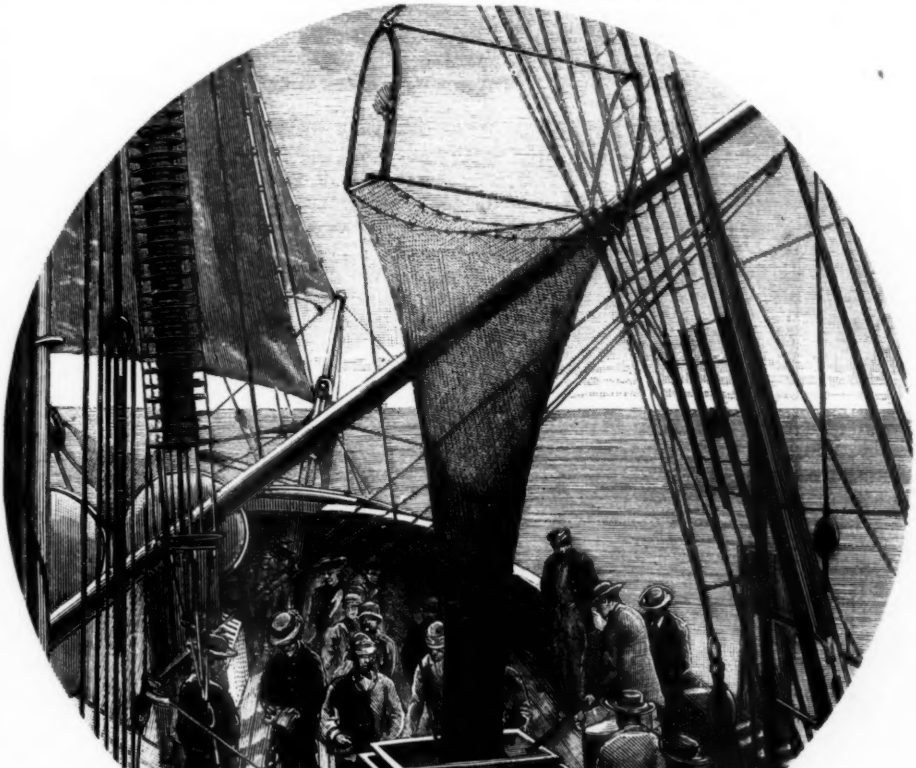


FIG. 11. — Examining the contents of a trawl.

The sampling of water from great depths is, as has been shown, a process which requires considerable time. Accordingly an attempt was made, on board the Talisman, to simplify the work when water was desired, not for the gases which it contained, but in order to investigate the germs which it held. The fol-

lowing plan was adopted. Thick glass tubes, narrowed at the ends, and closed by an enamelling-lamp after a vacuum had been previously formed, were attached to the metallic tube enclosing the thermometers. They were arranged in such a manner, that, when the overthrow of the latter took place, one of their slender ends struck the lower part of the metallic frame bearing the thermometer. Under this shock the point struck broke, and then the water rushed into the interior of the tubes, from which it could not make its escape on account of the small diameter of the entrance. At each sounding, therefore, a specimen of the water at the bottom was brought up; and it was very easy to preserve this by immediately sealing the tube.

Dredging at great depths requires considerable time, so that it often happens that the trawl can be brought on board only very late in the day. In the tropics night comes on early, the twilight in these regions being of short duration. To overcome this important difficulty, care was taken, while equipping the Talisman, to arrange electric apparatus capable of furnishing light so bright, that, when the trawl was raised during the night, it was possible to search with great care for the smallest objects brought up. For this purpose, a Gramme machine was placed upon the bridge, and was connected with a set of Edison lamps, lighting either the trawl or the interior of the laboratory. The lamps on the bridge were supplied with a reflector, allowing a bright light to be thrown upon the sea. Thus the approach of the trawl to the surface could be easily watched.

The Edison lamps used to light the ship were also useful, by floating in the water, in attracting fishes into the nets previously arranged. One can imagine the beauty of the scene when these brilliant lights are lowered into the water. The surrounding sea is illuminated with dazzling and constantly changing rays. It seems as if one were watching beautiful medusae, which, like bright disks, rise and fall with the waves, turn and disappear, to rise again a few minutes later more sparkling than ever.

FIG. 12. — Effect of expansion on the air-bladder of a fish taken from a depth of fifteen hundred metres.

Contrary to expectation, the deep-sea fish brought to the surface are somewhat affected by the expansion they have experienced. Many fishes possess a peculiar organ, consisting of a closed sac situated

above the intestine, against the spinal column. The presence of this air-bladder allows a fish to rise and sink with great ease. In the case of a fish taken at a great depth, and brought to the surface, the gases enclosed in this bladder expand to a very considerable extent. As a result, the bladder presses upon the abdominal wall, and, as this expands, it gradually loses by abrasion the scales which cover it. When the expansive limit of the bladder is reached, its lower end pushes against the stomach, on the head of which it rests, enters the mouth, and leaps outside. The pressure which is thus brought to bear on the upper wall of the mouth-cavity is so great that it yields, and the eyes are forced from the sockets. We have endeavored, in fig. 12, from a specimen in the exhibition of the Talisman, to show in what state fishes caught at a great depth are brought to the surface. The same enormous pressure, brought to bear upon the collecting implements, may be understood

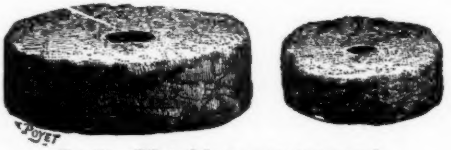


FIG. 13.—Effect of deep-sea pressure on cork.

from the injury to one of their parts. In order to keep the mouth of the trawl-net open, there is arranged within a set of large cork disks strung on a string. These disks, when new, have a rather large diameter, but after a few days' use they shrink to about half their original size. Under the pressure exercised, the tissue of which they are made settles considerably, and at the same time becomes as hard as wood. Fig. 13 shows different sides of two of the disks,—one before use, the other after,—drawn upon the same scale.

THE USE OF NAPHTHALINE AS AN INSECTICIDE.[1]

NAPHTHALINE, in one form or another, has for some time been used by entomologists as a means of preventing injury to their collections from Acari, Psoci, Dermestes, Anthreni, and other museum pests. My own experience is, that it destroys the Acari and Psoci, but not the other pests, though it tends to repel them. Recent investigations would seem to indicate that it may be used to advantage in the field as an underground insecticide. It appears that as early as 1842 a French physician, Rossignon, pointed out the possible use of naphthaline, not only as a remedial agency in medical practice, but also as a substitute for camphor, for the destruction of museum pests. But up to the appearance of the grape Phylloxera in France, no serious experiments were made with it in the field. Among the substances tried against this pest, naphthaline played its part. The efficient ingredient in the 'poudre insectivore' of Peyrat, was, according to Maurice Girard, naphthaline; but the experiments with it did not yield encouraging results.

Baudet recommended it to the French academy in 1872; while in 1874 E. Fallières proposed gypsum saturated with naphthaline, the mixture to be distributed over the soil. It was also among the numerous substances experimented with by Messrs. Maxime Cornu and P. Mouillefert, the results of which were published in the well-known memoir presented by these gentlemen to the French academy in 1877. Naphthaline, up to this time, proved to be of little value in killing the insect, and of no value as a repellant. Nevertheless, Dr. Ernst Fischer of the Strassburg university, encouraged and induced by the most favorable results obtained with naphthaline as an antiseptic and as a destroyer of micro-organisms (moulds, Schizomycetes, Bacteria, etc.), has, since 1881, again experimented with it as a direct remedy for the Phylloxera; and he has given us the results of his experience in an interesting brochure lately received. The first part of Dr. Fischer's work treats of, and strongly recommends, the use of naphthaline for surgical purposes as an antiseptic superior, in most respects, to all other antiseptics now in use. His conclusions are based on extensive experiments showing the effect of the material on the lower organisms, and prove, that, properly used, it not only arrests the growth of these micro-organisms, but eventually destroys them. This part of the work will be of especial interest to those who are experimenting with a view of destroying disease-germs. It is to the second part that I would here call attention. Preliminary to a statement of the results of this part of Dr. Fischer's work, a few facts in regard to the nature of the substance may not be out of place.

Naphthaline, a carbohydrate of the formula $C_{10}H_8$, was first made in 1820, by Garden, from coal-tar. It is volatile at any temperature, melts at 79.2° C., boils at about 214° C., and has a specific gravity of about 1.1. Essentially insoluble in water, alkalies, and diluted acids, it is easily soluble in ether, hot alcohol, hot concentrated sulphuric acid, and in many volatile and rich oils. It is readily carried off with aqueous vapors; so that, in order to quickly disinfect a room, it is only necessary to heat a vessel with water in which naphthaline has been put. The naphthaline gas mixes very readily with atmospheric air, and is also readily taken up by water. It is not poisonous to man or to the higher animals, and, for surgical purposes, should be used chemically pure. The crude material is by far cheaper; and, upon inquiry, Dr. Fischer found that in London it can be obtained, without barrels, at 25 marks ($6) per 1,000 kilograms (about 2,200 pounds), in Paris at 100 francs, and in Cologne at about 45 marks (barrels included). The crude naphthaline contains more or less phenol and creosote, and is a stronger insecticide than the purified article, but also more injurious to plants. Dr. Fischer used the purified naphthaline in his experiments on Phylloxera, but thinks that with some pre-

[1] Das naphtalin in der heilkunde und in der landwirthschaft. Von Dr. Med. ERNST FISCHER. Strassburg, *Trübner*, 1883.

caution the crude material might safely be used, especially if it is not brought in direct contact with the plant, or if used in the dormant season.

The experiments with phylloxerized grape-vines were carried on under direction of Dr. Fischer at La Grave d'Ambarès, near Bordeaux. Fifteen badly infested stocks,[1] partly growing on light, partly on heavy soil, were treated in April, 1883.

It was placed in a hole dug in the ground near the main root, and subsequently covered up; and the quantity used was on some plants one, and on others one-half, kilogram. On Sept. 18 the plants were examined, with the following result: all plants experimented with, but especially those treated with the largest quantity of naphthaline, showed a new and healthy growth of numerous long, fine rootlets, which were perfectly free from Phylloxera: in fact, the Phylloxera had entirely disappeared from the roots of all plants experimented with, whereas several plants not treated with naphthaline showed no young growth of rootlets, and an abundance of Phylloxera. The growth above ground, of the plants treated, showed no difference as compared with plants not treated, — a fact explained by insufficient time for the treated plants to recuperate. Some of the most vigorous new rootlets were found to have penetrated the layer of naphthaline, thus showing that the latter has no injurious influence upon them. A considerable quantity of the naphthaline was found unchanged at the date of examination, which shows that the evaporation is very slow, and that its effects will be correspondingly lasting.

The results are certified to by official affidavits, and were more marked on plants growing in heavier and moister ground than on those in light and gravelly soil.

As the most convenient mode of application, Dr. Fischer recommends that about one kilogram of the naphthaline be put in a trench dug around the plant a few inches from the stock; the trench to be not less than from fifteen to twenty centimetres deep, and to be at once filled up again. He attributes the failure of former experiments, 1, to the small quantity of the material employed; 2, to its being employed too near the surface of the ground, so as to permit evaporation in the air. He also thinks that results were expected after too short a lapse of time. C. V. RILEY.

RECENT DETERMINATIONS OF STELLAR PARALLAX.

DR. DAVID GILL, director of the Cape observatory, has presented to the Royal astronomical society of London the results of the heliometer determinations of stellar parallax made by him and Dr. W. L. Elkin. The distances of each star, the parallax of which was sought from two comparison-stars situated on opposite sides of it, were measured at the times when the effect of parallax was least and when it was greatest.

[1] It is not stated whether the roots of these stocks were examined at the time, to ascertain whether or not the Phylloxera was still at work.

The following were the results obtained for the stars observed: —

	Parallax.	Probable error.
α Centauri	+ 0″.75	± 0″.61
Sirius	+ 0.38	± 0.01
ϵ Indi	+ 0.22	± 0.03
Lacaille, 9,352	+ 0.28	± 0.02
o^2 Eridani	+ 0.166	± 0.018
β Centauri	− 0.018	± 0.019
ζ Toucani	+ 0.06	± 0.019
e Eridani	+ 0.14	± 0.020

The probable error of a single observation by Dr. Gill averaged 0″.1, and of a single observation of Dr Elkin, 0″.16. The determinations had all been made with the Cape heliometer of four inches aperture, and with a power of a hundred and seventy-five diameters.

Dr. Gill refers to the importance of parallax investigations in order that our knowledge of the sidereal system may be advanced. We do not know at present whether bright stars, or stars having large proper motions, are the more likely to give large parallaxes. There are, therefore, two questions to be solved, — first, what is the average parallax of stars of the first magnitude, of stars of the second magnitude, of the third, and so on? and, second, what connection is there between the parallaxes of the stars, and their proper motions? The present series of measures shows that the parallax of a star can be determined from sixteen measures with a probable error of ± 0″.02, assuming that the observations were free from systematic errors. With a more powerful instrument, which would give a greater choice of comparison-stars, it would seem that any systematic errors might be eliminated. There are sixteen stars of the first magnitude in the southern heavens: a similar number of stars might be selected of the second, sixteen more of the third, and so on. In making these observations, a reversing-prism should always be employed, as in the Cape measures, that the results may not be affected by the position of the comparison-stars. It should always be borne in mind that measures of two or more pairs of stars are much better than repeated measures of the same pair of comparison-stars. Another most necessary precaution is the use of screens to render the two stars equal in brightness. The heliometer employed should have a considerably greater light-gathering power than the Cape instrument, that there may be a freer choice of comparison-stars. It should be of at least seven inches aperture. A considerably higher power than the one used in the Cape determinations should also be employed. A single observer, by making two hundred or two hundred and fifty observations each year, might complete the entire series in the course of ten years. This is a work urgently demanded in the interest of sidereal astronomy, and one that should be undertaken without hesitation or delay.

The heliometer of the observatory of Yale college is yet more powerful and perfect than that of Dr.

Gill at the Cape observatory, and it is hoped that Dr. Elkin will employ it in continuing these remarkable measures. We believe that no method of determining stellar parallax, so accurate and expeditious as this, has ever before been at the command of astronomers.

SIMON NEWCOMB.

CARNIVOROUS HABITS OF THE MUSKRAT.

AT a recent meeting of the Biological society of Washington, a paper was read by Mr. Henry W. Elliott, setting forth an entirely new fact in regard to the diet of the common muskrat (Fiber zibethicus), proving that carp-ponds in the west are being completely devastated by this animal. Ponds which should produce many carp are almost entirely barren; and for a long time the owners have been unable to account for it, no hawks being seen, there being no possibility of escape from the ponds, and in some it being impossible for other people to take them with a seine on account of obstructions placed in the way to prevent this. It was finally suggested, and afterwards proved conclusively, that muskrats were the miscreants. Carp have the stupid habit of sticking their noses into the mud during the winter, and hibernating; thus rendering it possible for so clumsy an animal as a muskrat to obtain them easily, — a thing which it would probably do in winter, when roots, etc., its natural food, are hard to obtain. If it be a fact that the muskrat has acquired the habit of eating carp, immense damages are likely to result, unless speedy and extreme measures be taken; for, under these circumstances, such a sluggish and poorly protected fish as the carp can hardly be expected to resist or avoid its enemy, but will become its easy prey: and thus one of the most important works of the fish-commission, from which such great economic benefits were expected, will result in nothing. As a means of getting rid of these pests, so hard to shoot, and not easily trapped, poisoning by means of strychnine placed in apples was suggested as the best, it having been applied with success in many cases. In his communication, Mr. Elliott asserted that in no monograph of the animal could he find any mention of the diet of the muskrat, other than that it was an exclusive vegetarian, and, so far as he could ascertain, this was the first time that the carnivorous appetite had ever been brought before scientific men; in which statement he was sustained by an authority upon mammals, present at the meeting. This was surprising to many; for it seems to be well known, as was proved by the discussion which followed the paper, that the muskrat will, and does frequently, under favorable conditions, eat animal food. One gentleman mentioned that he had seen muskrats take bait, and even live fish, from his hook, while fishing in fresh water. The piles of Unio shells frequently seen upon the tops of muskrat mounds, also prove conclusively that it will at times eat animal food. It is noticed that the shells are always perfect, not even having chipped edges; and it would seem strange that this should be so, unless we supposed that they were left to die before being eaten, the meat then being easily picked out.

The muskrat is not the only rodent which departs occasionally from a vegetable diet; for such animals as the squirrel and capybara are, and have been for a long time, known to eat flesh when the circumstances are favorable. Mice and rats, of course, are well known to be omnivorous, eating animal food as quickly as vegetable, this being the partial result of contact with man. In the other orders of herbivorous mammals, examples of deviations from the normal class of food are frequent, especially under domestication: for example, the feeding of fish to cattle; while, under similar conditions, the carnivorous dog and cat can be made to eat vegetables or vegetable products. By thus adding one more animal to the number of recorded species which will adopt an opposite diet from the natural, Mr. Elliott is deserving of credit; for, notwithstanding the fact that it is known to some, still it has never been placed before the scientific world in any recognized monograph or treatise upon Rodentia.

RALPH S. TARR.

CONDITIONS OF GROWTH OF THE WHEAT-RUST.

THE last part of the journal of the Royal agricultural society of England has sixty pages devoted to a 'Report on wheat-mildew.' Mr. W. C. Little prepared an extended list of questions concerning the wheat-mildew, or wheat-rust (Puccinia graminis), to which a large number of answers were received from British farmers who had suffered from the rust. From these reports it is gathered, that the rust is more prevalent in those localities where the atmosphere is most moist. Spring frosts, heavy rainfalls, and violent changes of temperature, encourage rust. Hot weather, with frequent thunder-storms, is most favorable for the rapid development of the fungus parasite. Some of the observations point toward the belief that about eleven days are required for the full development of the Puccinia after it has entered the wheat-plant.

Perhaps the most valuable results of the compiled answers are those upon the relation of soils to the rust. The pest is more prevalent on peat and clay soils than on gravel or light lands. Drainage is a partial preventive of rust. High farming encourages the development of rust, especially if the wheat is rank, and it becomes lodged or fallen. There is an agreement of opinion that rust prevails in wheat sown after clover. Newly broken up lowland pastures are seldom sown to wheat because so sure to become rusted.

Dr. J. B. Lawes holds the view that plants are liable to the attacks of parasites, either insects or fungi, in proportion as the soil is deficient in available mineral food. Common tilled land contains about ninety-seven per cent of mineral matter, and three per cent of vegetable substance. The lowlands have this proportion nearly reversed. Dr. Lawes says, "Plants are very much like ourselves: their power to escape disease, and to struggle against

it when attacked, depends very much upon their state of health." Dr. Voelcker, the chemist of the Royal society, has said, "I believe the soil has a great deal to do with mildew. An excess of available nitrogenous food appears to me to have a decided tendency to cause mildew in wheat. A clover-crop leaves a large amount of nitrogenous matter in a soil, and renders wheat following it liable to attacks of rust." Dr. Voelcker further agrees with Dr. Lawes when he says, in answer to Mr. Little's letter, "A sudden check by cold or continued wet weather has a decided tendency to favor the attacks of mildew in wheat; and this tendency is greater in highly manured land than in poor soil, or, at all events, on land which is manured with too much nitrogenous food, or on land naturally rich in such food." Four widely different soils upon which wheat had been grown were analyzed by Dr. Voelcker, and it was found that the amount of mildew determined by extended observations varied directly with the per cent of nitrogenous matter in the soil. But much depends on previous cropping, and therefore the ratio between mildew and nitrogenous matter in the soil may vary to a limited extent.

The large amount of evidence gathered, and presented in extended tables, shows that some sorts are more capable than others of resisting rust, though no varieties are rust-proof. White wheats suffer more than red sorts. It is best to sow early maturing varieties, and sow them early.

Byron D. Halsted.

New York.

THE CODEX CORTESIANUS.

Codex Cortesianus, manuscrit hiératique des anciens indiens de l'Amérique Centrale conservé du Musée archaeologique de Madrid photographié et publié pour la première fois avec une introduction et une vocabulaire de l'écriture hiératique Yucateque. Par Léon de Rosny. Paris, *Maisonneuve*, 1883. 26 + 49 p., 42 pl. 4°.

This volume by Léon de Rosny is undoubtedly the most important contribution to Central-American paleography which has appeared since the publication of Landa's 'Relacion,' and the 'Manuscrit Troano' by Brasseur de Bourbourg. In it we have a photo-engraved reproduction of the recently found aboriginal manuscript known as the 'Codex Cortesianus,' thus adding one more to the brief list of pre-Columbian Maya documents which have so far been discovered. The name 'Cortesian' has been applied to it because of the supposition that it had once belonged to Hernando Cortez.

Up to 1876 but three of these manuscripts — the 'Dresden codex,' the 'Codex Troano,' and the 'Codex Peresianus' (or 'Manuscrit mexicain No. 2') — had been brought before the public. About this time a proposition was made to the Bibliothèque impériale of Paris by some one in Spain (the name is not given) to sell to it an ancient American manuscript. A photographic copy of two pages accompanied the proposition as specimens of the volume. On account of the high price demanded, the proposition was not accepted. Shortly afterwards it was obtained by the Spanish government, and deposited in the archeological museum at Madrid. One of these two pages was copied by Mr. Rosny in plate 11 of his "*Essai sur le déchiffrement de l'écriture hiératique de l'Amérique Centrale;*" and the other, which is beyond question a missing half of the initial page of the 'Codex Troano,' in plate 5 of his "*Documents écrits de l'antiquité américaine.*"

In 1880 Mr. Rosny went to Madrid expressly to see and study this codex, and, if possible, to obtain a copy of it. Through the kindness of Don Juan de Dios de la Rada, the curator of the museum; his mission was eminently successful, as he was permitted, not only to examine it, but to make two complete photographic copies of it. It was from these, I presume, that the plates of the present work were made.

We learn from the introduction, that the original, like the other three Maya manuscripts, is written on both sides of a strip (probably of Maguey paper) covered with a coat of white paint. Judging by the specimen given in Mr. Rosny's '*Essai sur le déchiffrement*,' plate 11, I presume the figures are partially colored, though not so highly nor to the same extent as in the Troano manuscript; but unfortunately this is not shown in the present work.

The general appearance, the figures, the form of the characters, and numerous other particulars, prove very clearly that it is more closely related to the Troano manuscript than to any other one of the Central-American codices. This is so apparent, that Mr. Rosny has suggested that the two are parts of one original work. The fact that we find here the missing half (by this we know that one-half is missing) of the 'titlepage' of the Troano manuscript is a very strong argument in favor of this view. Still, I am disposed to doubt its correctness, for the following reasons: 1°. On plates 39 and 40, upper division, we find an exact repetition of the five figures in the top division of plates 29 and 30 of the Troano manuscript; 2°. In the plates of the latter half, quite a number of numerals are introduced into the text, and joined to characters to which they are never attached in the manuscript; 3°. The form of the serpent-figures (no one can fail to remark the strong resemblance between the heads of some of these serpent-figures and the dragon-

heads on the pyramid of Xochicalco) ; 4°. The presence on plate 25 of a character found nowhere else in the Maya manuscripts except in the 'Dresden codex;' 5°. The peculiar bird-headed figures on plates 20 and 21; 6°. The numerous eight-day columns in the latter half, and a number of other minor peculiarities which might be mentioned.

But be this as it may, it does not affect the value of the codex; and we can join heartily with Mr. Rosny in esteeming it a truly 'precious document,' and extend to him our sincere thanks for bringing it to light.

Another peculiarity in this codex, worthy of special notice, is the *grand tableau cyclique*, as Rosny terms it, which commences on plate 13, and continues regularly in four lines on plates 14, 15, 16, 17, and 18.[1] The plan of this table (which is constructed upon an entirely different idea from the one which somewhat resembles it in form in the 'Codex Peresianus') so strongly resembles the cyclic tables, or Tonalamatl, in the 'Codex Bologna' and other Mexican codices, as to suggest the possibility of relation. In this case the series commences with *Ymix*, as Landa asserts was the custom. This table, as Mr. Rosny rightly affirms, furnishes us new data in relation to the Maya calendar, and may possibly enable us to untie some of the knots in that tangled skein.

A large portion of the introduction consists of a long extract from a paper on the Maya Calendar by Mr. Bouilhet presented to the Société américaine of France by Mr. Delaporte in 1880, but never before published.[2] The larger portion of this extract is devoted to a discussion of the Maya cycles, which leads the writer to the conclusion that the Ahau, or *Ahau-Katun* as he designates it, consisted of twenty-four years, and the Grand cycle of three hundred and twelve, agreeing in this respect with Perez. On the other hand, in attempting to adjust the years of the Maya system with those of the Gregorian calendar, he decides that the year 7 *Cauac* could not have been the first of an Ahau and at the same time the year 1392, as supposed by Perez. He agrees on both these points with my conclusions.[3] I judge from his language, and the figure of the calendar-wheel he gives, that he assigns *Kan* to the east, *Muluc* to the north, *Ix* to the west, and *Cauac* to the south; and hence follows Cogulludo and Perez, in which I believe he is correct.[1]

[1] See note on p. 20, of my Study of the Manuscript Troano, where that part of the table found on plate 14 is given from the copy in Mr. Rosny's *Essai sur le déchiffrement*, plate 11.

[2] It was put in press, and the first proof struck off; but for some reason its publication was then renounced. The title of the article, as we are informed by Mr. Rosny, who possesses the manuscript, is *Recherches mathématiques sur le calendrier Yucatèque*.

[3] Manuscript Troano, pp. 29 and 50.

Mr. Rosny calls attention to the fact, that most of the European *savants* appear to be unacquainted with the various works and articles relating to the antiquities of Central America which have appeared within the last few years in America, and in a note and elsewhere in his introduction mentions most of them.

The vocabulary at the end of the volume contains a list or series of the signs or symbols of the Maya days, and the numerous variants found in the different codices; of the months; of the numeral characters; of other single characters, of which a probably or possibly correct signification has been given by him or other authorities; and, lastly, a list of character groups which have probably been correctly determined. The entire list is numbered consecutively.

It may not be out of place to state here, that I have discovered with satisfactory certainty that No. 17 of this vocabulary, which is the same as fig. 96 (p. 159) of my 'Study of the Manuscript Troano,' and is found in all of the Maya codices, is not a variant of *Cimi*, as he supposes, nor a death-symbol, as I surmised, but a symbol of the number *twenty*, and, if phonetic, of the Maya word *Kal*. This is readily determined by its position in various series of numbers in the different codices; as, for example, in the extended series in the third or lower division of plates 33 to 47 of the 'Dresden codex,' where the presence of days, by their succession, enables us to determine with absolute certainty the correctness of this conclusion. This fact compels me to differ from Rosny in his interpretation of group No. 224 of his vocabulary, and found on pl. 15.* of the 'Codex Troano.' Instead of *Cotz* (a 'divider' or 'sculptor') I would read *Cakal* ('twice twenty,' or 'forty'). Then this, together with the figure of the hatchet (which is certainly not phonetic), would signify that the artist should give twice twenty strokes or cuts, or draw twice twenty lines, with his machete, on the wooden image which he is carving.

The red diamond-shaped character so common in this codex in connection with numeral characters is also another symbol of the number twenty.

That Rosny is largely influenced in his interpretation of characters by Landa's alphabet and the names of the days, is quite perceptible in this vocabulary. I am satisfied that no

[1] I have discussed this subject in a paper to be included in the third annual report of the bureau of ethnology, now in the hands of the printer for publication.

decided progress can be made in deciphering these aboriginal documents until we break loose from these trammels, and use as a key the few characters which can be satisfactorily determined otherwise. The attempt, on the part of this author, to use the two classes as a basis, leads him into some inconsistencies. For example: he interprets his No. 176 (a cardinal-point symbol) as *Likin* ('east'), and No. 231 as *Ahau-al* ('enemy'); yet the leading character in both groups is the same, — the symbol of the day, *Ahau*. If the characters are phonetic, this is inconsistent; if they are not, then each must be determined independently.

I notice a number of clerical errors in the vocabulary, most of which can be readily corrected: therefore I only call attention to a few which may possibly lead to error. Under No. 174 the reference to No. 188 should be to 190. Under 178, *Sud* ('south') should be *Ouest* ('west'). Under No. 192 reference to 188 should be to 189. Under No. 200 reference to 199 should be to 201.

Of this work only eighty-five copies were published; and of these, as I learn elsewhere, but thirty-five or forty were to be offered for sale. CYRUS THOMAS.

KELLERMAN'S BOTANY.

The elements of botany, embracing organography, histology, vegetable physiology, systematic botany, and economic botany. Arranged for school use or for independent study. By W. A. KELLERMAN, Ph.D. Philadelphia, *Potter*, 1884. 360 p., 354 fig. 12°.

TEACHERS of classes composed of beginners, to whom they wish to impart some knowledge of botany aside from the rudiments of phenogamic analysis, have long felt the need of an elementary text-book a little more comprehensive in its scope than books of this grade usually are, and they turn to every book like Professor Kellerman's with some expectation.

So far as its scope is concerned, this little treatise leaves nothing to be desired. Besides the topics indicated on its titlepage, it briefly treats of vegetable paleontology and the geographical distribution of plants. In the main, each topic is fairly presented, considering the needs of the pupils for whom the book is written; but a lack of care in the final revision of the manuscript is frequently noticeable in badly constructed sentences; and those minor errors which so persistently make their way into text-books written by the most competent authors are found pretty liberally scattered through the pages. Even more serious than these are several statements, which, from their brevity or other causes, are likely to mislead the reader: e.g., the generalizations concerning plant-food (p. 12), the office of the leaf (p. 15), the absence of chlorophyll in parasites (p. 19), and metastasis (p. 107), most of which are qualified in other places; and the statements with respect to the decay of insects captured by Nepenthes (p. 107), the growth from a single cell in all Pteridophytes (p. 154), and the necessity of extraneous aid in the pollination of all orchids, which find no correction. The usual number of old errors are further disseminated; e.g., the cotyledonary nature of the persistent leaves of Welwitschia (p. 165), the fertilization of dioecious Saprolegnieae by spermatozoids (p. 134), the intercommunication of tracheides through their bordered pits (p. 75), and free-cell origin 'about new centres of formation' in endosperm, etc. (p. 81).

The writers of several recent text-books have been unfortunate in illustrating their works: old and well-worn figures being borrowed, or home-made drawings being cheaply photo-engraved, for the occasion. The book before us unfortunately suffers in both ways. Quite a percentage of the illustrations are taken from the floral advertisements of the late Mr. Vick, and it must be said that few of them convey a correct idea of the plants they are named after. Nearly three hundred figures are original, and, properly executed, would add very greatly to the value of the book. As it is, they reflect much credit on the industry of the author; but several fall quite as far short of reality as the so-called 'cat' whose problematical contour puzzled the readers of a zoölogical text-book not many years since.

While the book is unsatisfactory in its execution in many respects, it comes nearer to filling a serious gap in botanical literature than any other thus far published; and, notwithstanding its shortcomings, it is a welcome addition to the teacher's auxiliaries, its low price allowing it to be put in the hands of students who could not afford a more expensive book in addition to the systematic manuals used by most elementary classes.

THE SOCIETY OF MICROSCOPISTS.

Proceedings of the American society of microscopists. Sixth annual meeting, held at Chicago, Ill., Aug. 7, 8, 9, and 10, 1883. Buffalo, *Haas & Klein, pr.*, 1883. 4 + 275 p., illustr. 8°.

THE proceedings of this society are published with commendable promptitude, and

are printed with general accuracy and neatness. The proceedings are given in full, together with certain reports and papers read. Of the reports, the most important is that of Prof. W. A. Rogers, upon the standard micrometer: it bears the stamp of that thoroughness and exactitude which characterize all Professor Rogers's work. This standard is a platin-iridium bar prepared and authenticated by the U.S. bureau of weights and measures: it is very well ruled, and the error in each of the ten one-millimetre spaces has been carefully determined. The bar will be preserved by the society with due care, and proper copies prepared of it.

The volume opens with President Albert McCalla's address, 'The verification of microscopic investigation' which is followed by twenty-six papers. These last are mostly by amateurs, and show it, for the most part, more plainly than is consonant with a high scientific value. There is, we believe, not more than a single communication which appears to be the result of a serious and prolonged research by an experienced investigator. In fact, a society of so-called microscopists must necessarily be an association principally of amateurs, because the professional worker is not classified according to the instrument he uses, but according to the subject he studies: the amateur studies, *non multum, sed multa*, and so may be a microscopist. Yet we find in the volume articles of interest and value. Among these, we may signalize Dr. Blackham's very sensible article on the selection of objectives; Dr. Holbrook's, on the nerves of the kidney, in which the valuable method of making frozen sections of fresh tissues to be treated with gold is described; and Mr. Belfield's, on the detection of lard-adulterations (if his results are confirmed, they will be a valuable addition to the means of hygienic supervision). Dr. Clevenger's article on the brain is fortunately given only in abstract. The remaining essays are for the most part light: some betray a lack of acquaintance with scientific literature, and a few are treated kindly by being left uncriticised.

The society is doing useful work; and, as its activity and experience increase, we may hope for a constant elevation of its scientific standards. We expect that the future volumes of its proceedings will contain a still larger proportion of valuable researches; but we think the society will achieve its highest utility if it constantly inculcates the importance of perfected methods of work, and fosters and extends technique, the *sine qua non* of progress in microscopy.

DARWINISM.

Darwinism stated by Darwin himself. Characteristic passages from the writings of Charles Darwin. Selected and arranged by NATHAN SHEPPARD. New York, *Appleton*, 1884. 16+351 p. 12°.

Charles Darwin und seine lehre. Aphorismen gesammelt aus Darwin's eigenen werke und den werken seiner vorgänger und zeitgenossen. Leipzig, *Thomas*, 1884. 8+442 p. 12°.

It is rather remarkable that the idea of compiling a series of extracts from the writings of Darwin should have occurred, after so long an interval, to an American and a German at the same moment. No large theory of the operation of natural causes has ever had so brief a struggle for existence, or penetrated so rapidly and so deeply into the general mode of thinking, as Darwinism; and if no great necessity has been felt hitherto for an abridgment of his works, it is because they are so admirably clear and of such absorbing interest, that the general reader has not had much trouble in getting through them all in the original form. Mr. Romanes, however, says that admirers of Mr. Darwin's genius are frequently surprised at the ignorance of his work which is displayed by many persons who cannot be said to belong to the uncultured classes; and to those who have read nothing more than Mr. Romanes' own excellent presentation of the scientific evidences of organic evolution, 'Darwinism as stated by Darwin himself' will be just what is needed for their next stage of development.

It gives extracts, of a page or two in length on the average, from all Darwin's books. The order followed in the arrangement is not exclusively that of the books themselves, but is designed to present the reader with a connected view of Darwin's researches on plants and worms; on the development hypothesis in general, and its application to man in his physical and moral aspect; and on the influence of natural and of sexual selection, and of geographical distribution. The design of the compiler is carried out with a reasonable degree of success. No scientific man, of course, who has any regard for his reputation, openly reads an abridgment; but the general reader may well be thankful for this compilation, and the greatest physicist in the world is, after all, nothing more than a general reader in paleontology and the theory of groups.

What strikes one most, on turning over these pages, is the smallness of the addition which has been made to the general development theory since the publication of Darwin's two great works. Little or nothing has been done to change the main line of argument, or even

to increase its cogency. It is probably the only instance of a theory which has sprung from its author's brain fully grown, and armed at every point against its opponents; and it is in remarkable contrast to that great engine of mathematics which was invented by such men as Newton and Leibnitz, and which, nevertheless, has waited until comparatively recent times to be placed upon a thoroughly sound basis.

It is seldom that the press of any country brings out so poor an example of book-making as 'Darwin und seine lehre.' Its ostensible reason for existence is some recent action of the Prussian Diet; but the Prussian delegate must be a curious man, if he can shape his political course from any information which this book contains. There is no connection between the successive 'aphorisms,' and there is no reference to the volume or page from which they are taken. The extreme irksomeness of reading elegant extracts on any subject is naturally greatly intensified when the subject is one which depends for its interest on the cumulative nature of the evidence brought to bear upon it. One is surprised to find how Platonic an air sentences of Darwin's may have when separated from their context. No one would have believed that he has uttered so many fine sentiments. A selection from this selection would make a very respectable Darwin birthday-book. The extracts from predecessors and contemporaries, instead of making it plain just what had been said in the direction of Darwinism before Darwin's time, are also totally without any order or connection. They consist in such passages as these, — "Man is the great dash (*gedankenstrich*) in the book of nature" (*Jean Paul*); "Every being is as happy as it feels itself, not as I, with my intelligence, would feel in its place" (*Hartmann*); "Man was developed, not created" (*Oken*); "He who exists not, feels no kind of pain; annihilation, therefore, is not an evil" (*Fichte*), — together with others somewhat more to the point, chiefly from Haeckel and Büchner.

HOUZEAU AND LANCASTER'S METEOROLOGY.

Traité élémentaire de météorologie. Par J. C. HOUZEAU and A. LANCASTER. 2e ed. Mons, *Manceaux*, 1883. 324 p., illustr. 24°.

THE *Bibliothèque belge* for popularizing the sciences and arts includes this small volume as its second number. The authors have not succeeded in making it a very notable book, for it has about all the faults common to the many works of its class. It is essentially old-fashioned, except in the chapters on weather-services, which have a more modern flavor, although not of the best. Valuable space is given to the description of such instruments as the thermometer and barometer, which must already be familiar to a reader who has studied physics enough to appreciate the mention of expansion, radiation, and many other terms that receive no special explanation. The encyclopedic method is attempted: there seems to be a desire to say something of every thing, and consequently all mention of the *bora*, *mistral*, *föhn*, *sirocco*, *solano*, and *norther* is crowded into seven lines. It is a great mistake to suppose that the readers of popular scientific books will be content with such unsatisfying statements. The *föhn* may be a 'dry and warm wind,' but why is it so? The explanation involves some of the most recent and important applications of physics to meteorology, and a deliberate description of it would well replace the chapter on terrestial magnetism. But besides these errors, as they seem to us, in the plan of the book, there are implicit and explicit errors of fact. The low temperature of winter is regarded as the effect of the greater thickness of atmosphere through which the solar rays then pass, and no mention is made of their oblique incidence on the ground. The old error of two northern poles of minimum annual temperature is repeated. The less area of ice in the arctic than in the antarctic seas "must be attributed to the neighborhood of great continents which extend to the equator, and which transmit from point to point the heat thrown on the tropics." The maximum density of sea-water is given as 4° C. The equatorial current of the Indian Ocean is described as passing round the Cape of Good Hope, up and across the Atlantic Ocean, through the Gulf of Mexico, and thence as the Gulf Stream to Norway, without a word about the many branches on the way. Cloud-particles are considered chiefly vesicular; and their suspension in the air is said, before all, to be due to their electricity, which repels them far from the ground. The oblique motion of the trade-winds is wrongly explained, as usual, and part of their velocity is incorrectly regarded as an effect of the earth's rotation: they would flow faster if the earth stood still. The strength of storms is represented to be the simple direct action of the low pressure at their centre. 'Cyclone' is applied only to the Indian Ocean, and is said to be synonymous with 'tornado' in the United States. We cannot recommend the book.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Division of chemistry. — During February, Prof. F. W. Clarke and Dr. T. H. Chatard completed analyses of waters from Utah Hot Springs, Lake Tahoe, and from Alum Creek in the Yellowstone National Park. They have also analyzed some rocks and sediments collected in the Great Basin. —— Dr. Chatard has begun investigations into a new method of silicate analyses, the results of which promise to be of importance. —— Professor Clarke has analyzed halotrichite and alunogen from a large deposit at the head waters of the Gila, in New Mexico; saussurite from California; allanite from Topsham, Me.; a mineral near cimolite from Norway, Me.; a handsome chlorite from Georgetown, D.C.; and an exceedingly interesting variety of pectolite, simulating jade, from Alaska.

Professor Clarke has also completed the analyses of two more mineral-waters from Montana, collected by Dr. A. C. Peale last summer. One of them is a calcic thermal water from a spring in Emigrant Gulch, on the west side of the Yellowstone valley, opposite Bottler's ranch. This water contains .2350 of a gram of solid matter to the litre. The temperature of the water at the spring is 38°.8 C., and the flow of water is large. The other water is also from the Yellowstone valley, the spring being situated on the upper waters of Mill Creek, about ten miles due east from Riverside, one of the stations on the Park branch of the Northern Pacific railroad. Professor Clarke finds this to be a good mineral-water. It contains 3.8125 grams of solid matter to the litre, mainly sodium, magnesium, and calcium carbonates, with considerable sodium sulphate, and small proportions of chlorides. The water also contains iodine; but the quantity brought to the laboratory was too small to estimate its amount. This water is very agreeable to the taste. It resembles very much the 'Apollinaris' water from the valley of the Ahr in Prussia; and from this resemblance the springs have been named the 'Mill Creek Apollinaris springs.' The water is cold, having a temperature of 4°.5 C.

Mr. F. A. Gooch, formerly of the Northern transcontinental survey, has been appointed assistant chemist, to begin work in the laboratory at Washington April 1. —— Messrs. Barus and Hallock at the laboratory at New Haven, needing some capillary wire tubes, and being unable to find any, have succeeded in making them at the laboratory.

Crater Lake, Oregon. — Among the interesting places visited by Mr. J. S. Diller, in his reconnoissance of the Cascade Range last summer, was Crater Lake, about two or three miles west of Mount Scott. This is a body of water some three miles in diameter, lying in a depression some two thousand feet below the general level surrounding it. The sides are in general perpendicular, and the water is of a most beautiful tint. Toward the western end of the lake there is a small conical island, the rock of which resembles basalt, although Mr. Diller has not yet made a careful examination of it. The rocks forming the walls of the lake are andesitic. The general elevation of the country immediately about the lake is between two thousand and three thousand feet lower than the summit of Mount Scott. Capt. Dutton is convinced, from Mr. Diller's description of the lake, that it is homologous with the craters studied by him in the Hawaiian Islands. To the latter Capt. Dutton gives the name of 'caldeiros.' He says the first view of them does away with the idea that they are ordinary craters. They are huge caldrons or boiling lakes of molten rock.

Miscellaneous. — Capt. Dutton has received letters from Honolulu, by the steamer leaving there March 3, which state, that, for the few days preceding that date, the 'red sunsets' have been exceedingly brilliant. —— During February, Mr. Vanhise, one of Mr. R. D. Irving's assistants, prepared about fifty new thin rock-sections, among which were a large number of greenstones.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American society of civil engineers.

April 2. — The subject for discussion was the reduction of grades necessary to be made upon railway-curves to compensate for the increased resistance to the traction of the locomotive when traversing curves, in comparison with resistances encountered upon straight lines. The various forces composing such resistances have been combined in a formula deduced mathematically; but careful experiments which have been made tend to show that no formula has yet been found which is of general application. The rules adopted upon various great railway-lines were stated; but it was plain that additional information must be obtained before positive rules of general application could be given.

Chemical society, Washington.

March 27. — Papers were read as follows: F. W. Clarke, A new variety of pectolite from Alaska. —— Dr. J. H. Kidder, The use of the Nessler reagent in air analyses. In several cases the air-washings which were under examination gave a distinct, clear, green coloration in place of the characteristic yellowish-brown precipitate produced by ammonia. This color was also found in a few experiments upon rain and snow waters, but never in dealing with drinking-waters. Dr. Kidder is inclined to ascribe the new

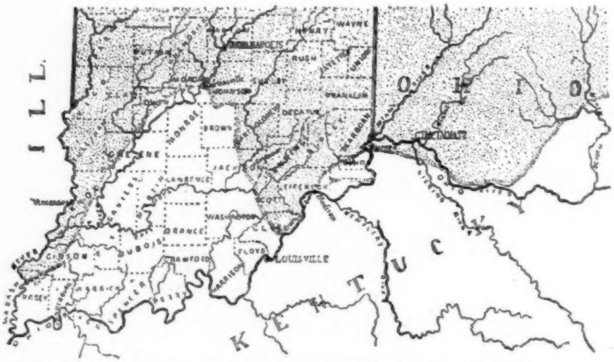
reaction to some organic amine, and hopes to continue the investigation of it. —— C. A. Crampton and H. W. Wiley, Bi-rotation of commercial starch-sugars, and a method of analysis based thereon. —— G. L. Spencer, A method for the determination of phosphoric acid in commercial fertilizers. This was essentially an improvement on the volumetric uranium process. —— H. W. Wiley, A method of determining the end reaction in sugar-reductions.

San Diego society of natural history.

March 7. — Mr. D. Cleveland made remarks relating to a tubular stone found in Temecula Cañon, supposed by him to have been used by the Indians as a pipe. Mention was also made of the Indians using the leaves of several species of Nicotiana (N. Clevelandi and N. Bigelovii) as a substitute for tobacco. —— A medium-sized olla was described by Mr. C. R. Orcutt as having been made by the Indians of Lower California in imitation of a teapot, with a nose and perforations in the side of the unglazed pot, and which was used by them to steep the leaves of Mentha Canadensis, L. —— Miss K. O. Sessions presented specimens of a rock from San Benito county, Cal., which is largely used in the adulteration of soap, and the best substance known for that purpose. —— Mr. Jos. Winchester presented a chart representing the comparative meteorology of San Diego (on San Diego Bay) and Poway (twelve miles from the coast) during the last five years; showing that the rainfall is greatly less near the coast than among the hills, while the humidity of the atmosphere near the coast is greater for ten months in the year than away from the coast. The explanation of the chart by Mr. Winchester was followed by a general discussion. —— Mr. C. R. Orcutt read a few notes on the native cacti, mentioning several undescribed species of this county and Lower California.

NOTES AND NEWS.

The detailed results of Mr. G. F. Wright's studies in 1882 and 1883, of the southernmost drift margin in the Ohio valley, are recently published by the Western reserve historical society. The pamphlet includes a revised reprint of Mr. Wright's lecture on glacial phenomena in the United States, from which we copy, in reduced form, the accompanying figure of part of the drift boundary in the states examined. Several other cuts illustrate the boundary by counties in much greater detail. The description of the district opposite Cincinnati, where the effects of ice-action are traced across the Ohio into Kentucky, is still confessedly incomplete; but, so far as observed, there is no question of the presence of true, unmodified glacial drift south of the river. It is to be noticed that another invasion of Kentucky is marked on the map here given, farther down the valley, at Madison; and that the retreat of the glaciated area towards Indianapolis seems to mark the division between two lobe-like extensions of the drift, which are now found to be frequently characteristic of the old ice-front, wherever studied in detail. The report attempts little of novelty in its subject-matter, being confined closely to questions of distribution; but the continual repetition of the familiar evidences of glaciation, — scratched rocks, heavy till, large granite bowlders, kames, and kettle-holes, — limited by a line of great irregularity, both horizontally and vertically, presents precisely the definite commonplace proof that is wanted in connection with the many scattered observations heretofore made.



MAP OF SOUTHERN INDIANA AND OHIO, SHOWING GLACIAL BOUNDARY.

— The trustees of the Peabody academy of science at Salem have decided to make a fireproof additional building, seventy by fifty feet, and two stories high. The additions to the ethnological collections, especially from Japan and Corea, have been very considerable during the past year.

— A recent calculation of the population and area of Australia states that there are only three human beings to every four square miles.

— The London society of arts has received a donation of twelve hundred pounds from one of its members, Mr. William Westgarth, to be expended on prizes for the best essays on dwellings for the poor, and the reconstruction of central London. The essays should include the following points: 1. The reconstruction of the central part of London with regard to the plan of the streets; 2. Removal of the old and poisoned soil; 3. Re-arrangement of the levels, and provision of subterranean ways for the accommodation of electric wires, pipes for water-supply, sewage, etc., and also provision for warehousing.

The prizes for these essays will be one of five hundred pounds, and one of two hundred and fifty

pounds. Three prizes, of one hundred and fifty pounds each, are to be given, either separately or to the writer of the larger essay, for the best treatment of the engineering, the architectural, and the sanitary considerations involved in the scheme. Mr. Westgarth's views as regards the prizes, and his hopes as to the value of the essays, may be fairly understood from a paper read by him at the Society of arts on Feb. 6, which embodied his own ideas on the question. The prize will be adjudged on Dec. 31, 1884.

— The researches of Dr. Angus Smith, one of the English inspectors under the Rivers pollution prevention act, have led him to the discovery that in all natural waters sugar ferments, and hydrogen gas is given off. The proportion of hydrogen given off varies with the organic impurity of the water, from the mountain stream to the worst sewage, so that the proportion of hydrogen evolved appears likely to prove a quantitative test of the activity or virulence of the microbes present in the water. Dr. Angus Smith's researches will probably be embodied in his next report. The importance of his discovery will be plain to every one familiar with recent micro-biological research, and suggests a test of the miasmatic condition of particular soils, and, of course, localities.

— A new French work by Dr. Bordier of the Paris School of anthropology, called '*Géographie médicale*,' gives an account of the geographical distribution of diseases, including a mass of information bearing on the relations between particular maladies, and climate, topography, and even race.

— We learn from the *Observatory* (March), that, in consequence of M. Houzeau's resignation of the directorship of the Royal observatory at Brussels, a committee, consisting of MM. Liagre, Mailly, and Stas, has been appointed to preside over that institution, and the following appointments have been made: M. Niesten has been appointed chief of the department of mathematical astronomy; M. C. Fievez is temporarily intrusted with the direction of the physical department, and, with M. Lagrange, has been promoted from the rank of assistant to that of astronomer; and M. Vincent has been promoted to the rank of meteorologist. Vol. iv. of the new series of annals has just been published, and contains, in addition to the meridian observations for 1879–81, drawings of the moon, observations of Jupiter's satellites, physical observations of Jupiter and of comets (*b*) and (*c*) 1881, and a study of the solar spectrum.

— The hydraulic method of mining has lately been used to remove some bluffs at the opening of the Dutch Gap canal. There had been trouble from caving in, obstructing the entrance. At the suggestion of Mr. C. P. E. Burgwyn, a powerful stream of water was directed against the banks, while a strong enough current was running to carry off the material as it fell, with a result highly satisfactory, as reported.

— It is said that a recent cold blizzard in southern Oregon killed thousands of robins and blue-jays, which usually winter in this latitude with safety. The birds have had no such experience since 1862.

— The bulletins of the Paris society of anthropology are always especially full on the subject of anatomy in its bearings on the natural history of man. Part iii. of vol. xvi. contains some very interesting papers of this description. M. C. Ikow, in discussing the color of the skin, eyes, and hair, says that a sufficient number of individuals in most ethnic groups will display a regular gamut of shades. Our knowledge of pigment itself is very imperfect. We do not know whether there is one pigment or whether there are several. It would be very useful to anthropology to know the chemistry of these pigments, the conditions of their occurrence, the influence of external and internal circumstances in modifying them. Domestication in animals produces great variability. It is therefore allowable to suppose that the endless variety in the environment of man occasioned by his occupying nearly all the earth, the endless variety of functional activities occasioned by the great range of food, etc., act similarly to domestication in animals. It may not be the sun immediately that turns the negro's skin black, and the Russian's hair white; but, mediately, the myriad physical movements consequent upon the sun's action act together to bring about the changes under discussion. Heredity must not be overlooked among the conservative powers. Mr. Ikow considers that there are fundamental eye-colors, just as there are fundamental race-forms. In opposition to Broca's brown, green, blue, and gray fundamental shades, he maintains that gray and blue eyes have no pigment whatever, their color being due to the structure of the iris. He further claims that Broca's colors correspond to no natural groups of humanity. The classifications of colors in the eyes, hair, and skin, are given in tabular form.

The most elaborate paper in the number is by Dr. René Collignon (pp. 463–526), upon the anthropometric elements of the principal races in France. It is well known that an effort is now making to replace the slow and unsatisfactory measurement of skeletons, of whose racial identity there must always be some doubt, with the much more convenient examination of the living. The Paris school of anthropology has two sets of observations, called the full and the abridged scheme; and the latter of these has been taken on a hundred Celts, a hundred Cymrians, fifty Lorrains, and thirty Mediterraneans (Catalans). These two hundred and eighty individuals are compared in every way which Collignon's genius could devise to give a scientific result. The variations imputable to height are the following: when the height increases, it is due to the augmentation of the length of the legs; all other parts diminish proportionally. So that the people are not far from wrong when they say of a tall man, 'He is all legs.' The only part of the body (except the special measures of the head and face) sensibly affected in its proportions by race is the trunk: it is long in the Catalans, short in the Celts, medium in the Cymri.

— The council of the Academy of natural sciences of Philadelphia announces that Prof. H. Carvill Lewis will deliver a course of twenty lectures upon the geology and mineralogy of eastern Pennsylvania,

beginning April 15. Every alternate lecture will be given in the open air, at different localities of geological interest in the neighborhood of the city. These field-lectures will take place on Saturdays, the excursions occupying the greater part of the day. The final field-lecture (June 21) will treat of coal and the methods of surface and underground mining, as illustrated in the neighborhood of Hazelton, Penn. Visits will be made to the mines of Mr. Coxe, at Drifton, and to the Hollywood colliery, near Hazelton, where the end of a coal-basin has been completely uncovered.

— It is hoped that the next annual meeting of the National educational association of the United States, to be held in the capitol building, Madison, Wis., July 15–18, will be the largest educational meeting ever held in this country.

— An extended course of instruction in mineralogy will be given by Prof. H. Carvill Lewis, at the Academy of natural sciences, Philadelphia, during the coming autumn and winter.

— The two remaining lectures of the course of free lectures under the auspices of the New-York academy of sciences, are, April 21, Recent discoveries in the prehistoric mounds of Ohio, by Prof. F. W. Putnam of Cambridge, Mass.; and, May 19, The glacial epoch in North America, by Prof. H. Carvill Lewis of Philadelphia.

— Dr. L. Waldo has just completed the erection of a normal clock at the Yale college observatory, to be used as a mean-time standard in the horological work of that institution. The movement and pendulum are parts of the gravity escapement clock built by Richard Bond (No. 367), and which had a phenomenal record under Mr. Hartnup at Liverpool, and later under Prof. W. A. Rogers of Cambridge. The case from Dr. Waldo's designs is built of cast-iron, with planed back and front, to which are clamped the plate-glass doors. The entire case rests upon two brick piers, which rise to the height of the movement, and insure stability to the pendulum suspension. Thermometers, a barometer, and a cup of calcic chloride, are placed within the case, which can be exhausted to any barometric pressure desired by an air-pump attached to its side. The escapement, and arc of vibration, can be observed and adjusted with the greatest accuracy. The clock is erected in the clock-room of the observatory, which was specially built to secure uniformity of temperature.

— During the week from June 28 to July 5, inclusive, it is proposed to institute a summer school of geology at the Delaware Water-Gap, Monroe county, Penn. Those desiring to join this class should make application to Prof. H. Carvill Lewis, Academy of natural sciences, Philadelphia.

— In the neighborhood of the Puerto de Toledo, Madrid, the manufacture of artificial whalebone has been started. It is made from the horns of black cattle and buffaloes. It is said that the factory is provided with all modern improvements, and that its products are already competing successfully with similar articles which are imported from abroad.

— The *Engineer* of Feb. 1 gives a very easy practical suggestion for preventing the boiler-explosions which occur so frequently in the early morning, while the boilers are being fired up, after standing with fire in all night, and the water on the simmer. It is suggested that a little air and cold water should be forced into the boiler before vigorous fires are made, so as to impart some air to the water, and lessen its superheated condition.

— The new Sydney paper, *The Australian graphic*, is illustrated by typographic etchings on glass plates made by the process of Mr. H. S. Crocker. The writing or drawing is executed with a resist crayon, made of a waxy material; and it need scarcely be said that hydrofluoric acid is used as the etching-fluid. It has been noticed that the tendency to undercutting is remarkably small, so that no precautions are required but an occasional stopping-out of the finer parts. The glass plates are cemented down on metal blocks for use in the printing-machine; but it is not stated how the clearing-out of large whites, and the turning of the blocks, are effected. It is said that the inventor originally intended to print from electrotypes taken from the glass; but this is found unnecessary in practice, as no inconvenience is caused by the use of the glass itself in the printing-press.

— M. Poincaré has been investigating the physiological action of petroleum-vapors, and gives his results in the *Journal de pharmacie et de chemie*, vii. 290. He found that an atmosphere charged with petroleum-vapors, such as is respired by workmen engaged in the petroleum industry, proved fatal to guinea-pigs after periods of exposure of from one to two years. Dogs and rabbits, under similar treatment, manifested languor, and loss of appetite. The work-people themselves complain only of an irritation of the membrane of the nose, and headache. It is nevertheless evident, that precautions should be observed, to prevent, as much as possible, the respiration of these vapors by the human subject.

— The fourth part of the transactions of the Ottawa field-naturalists' club shows marks of unusual activity on the part of so small a society (one hundred and thirty members), printing reports of no less than six different branches. The scientific papers are very fitly concerned mostly with local natural history.

— Sixty-nine species of butterflies are credited to Maine, and briefly described by Prof. C. H. Fernald in a paper of 106 pages, appended to the annual report of the State college of agriculture and the mechanic arts, at Orono, Me., for 1883.

— The catalogue of stars prepared from observations at the Glasgow observatory, extending over the years 1860 to 1881, has just been published by Professor Robert Grant, the Royal society having contributed largely toward the expense of printing from the government-grant fund.

— Mr. W. Mathieu Williams, in his usual science notes for the *Gentleman's magazine*, mentions an ingenious application of oxalic acid by saturating blotting-paper with it. The blotting-paper will then not

only absorb the excess of ink from a blot, but will remove the blot altogether; provided, always, the ink be of the old-fashioned kind, unmixed with indigo or aniline color. Such blotting-paper may, however, deal with signatures as well as blots: this is one reason for using the inks that are not entirely dependent upon the iron salt. Oxalic acid, however, is not very dangerous as a means of fraud, seeing that a trace of the writing, or the blot, remains; and this may be brought out again into full legibility by adding ferrocyanide of potassium or gallic acid.

— In his lecture given in London on house-drainage, Capt. Galton drew attention to the formation of nitre in the organic remains in the subsoil of old cities and villages. The wells of Delhi were at one time completely contaminated thereby; and there are many factories of saltpetre in India whose supplies are derived from this source. During the English blockade of European ports, Napoleon I. procured his nitre for gunpowder from the subsoil of Paris. The *Engineer* remarks that the conversion of ancestors into explosive material is more objectionable than Shakspeare's ultimate fate of Caesar, — to 'stop a hole to keep the wind away.'

— The Worshipful company of grocers, one of the old London guilds, has endowed a prize of a thousand pounds, to be offered once in every four years, and to be awarded for the discovery of any proof with regard to a subject in connection with sanitary service named by the company. The first essays for this discovery prize which is to be open to universal competition, British and foreign, are to be sent in by Dec. 31, 1886, the following problem being the test: "the discovery of a method by which the vaccinum contagium may be cultivated apart from the animal body, in some medium or media not otherwise zymotic; the method to be such that the contagium may be, by means of it, multiplied to an indefinite extent in successive generations, and the product after any number of such generations shall (so far as can within the time be tested) prove itself of identical potency with standard vaccine lymph."

— The memorial tablet to Elihu Root, lately professor of mathematics and physics in Amherst college, and which was destroyed in the burning of the Walker Hall two years ago, has recently been restored to its former location in the philosophical lecture-room of that building. The inscription reads as follows: —

"IN MEMORY OF
ELIHU ROOT,
PROFESSOR IN THIS COLLEGE FOR FOUR YEARS.
Born Died
Sept. 14, 1845. Dec. 3, 1880.
'SPEREMUS.'
A.D. 1883, restored from the fire of March, 1882."

This memorial was originally erected in June, 1881, by the graduating class of that year.

— The *Seconde société de Teyler*, of Harlem, has offered again its gold medal for a satisfactory essay "to furnish a critical study of all that has been said for and against spontaneous generation, especially during the last twenty-five years." The competing essays should be sent to the society before the 1st of April, 1886.

— By a happy accident, just as a plan for a topographical survey of Massachusetts is being considered, the discovery has been made of some original unpublished documents, relating to the former geodetic survey, by Borden. One is a letter of forty pages, addressed to the Hon. Theophilus Parsons, then chairman of the joint committee of the legislature, in which Mr. Borden reviews the whole matter of the state survey, describing in a very simple manner the methods used and the results obtained, and concluding with a detailed statement of the expense of the work from 1830 to 1841: the other is a paper addressed to the American academy of arts and sciences, dated August, 1850, in which is described in great detail, accompanied by carefully-drawn plates, the base-measuring apparatus, devised, constructed, and used by Borden in measuring the base-line in the Connecticut valley. The work done with this apparatus was of the most accurate character, the difference between two measurements of a line over seven miles long being less than a quarter of an inch. This paper was never sent to the academy; but, after various wanderings, both have reached the hands of Professor Vose of the Massachusetts institute of technology, who has presented them to the academy. It is to be hoped that the academy will print them in full at an early day.

— Messrs. Henry Edwards and S. Lowell Elliot announce that they will publish from time to time independent monographs of North-American Lepidoptera, with colored illustrations, prepared by different American entomologists. Ten are already announced by Dr. A. S. Packard, Messrs. Roland Thaxter, Eugene M. Aaron, R. M. Stretch, W. H. Edwards, B. Neumogen, and the futherers of the enterprise. They are to be published at only a slight advance upon the actual cost.

— In view of the communication by Dr. Bradner to the Academy of natural sciences at Philadelphia, reported on p. 334 of *Science*, a correspondent from Newark, O., warns us that any inscribed stones said to originate from that locality may be looked upon as certainly spurious. Years ago certain parties in that place made a business of manufacturing and burying inscribed stones and other objects in the autumn, and exhuming them the following spring in the presence of innocent witnesses. Some of the parties to these frauds afterwards confessed to them; and no such objects, excepting such as were spurious, have ever been known from that region.

— Mr. Winfred A. Stearns proposes, if a sufficient number of subscriptions can be procured, to publish at Amherst, Mass., under the auspices of the Massachusetts agricultural college, a scientific journal, to be devoted exclusively to the interests of natural history in the state of Massachusetts, and to be called the *Bulletin of the natural history of the state of Massachusetts*.

— Among recent deaths, we notice those of Dr. J. W. Gintl, professor emeritus of physics and mathematics, at Graz, Dec. 22, 1883, in his eightieth year; Ch. H. Merrifield, Jan. 1, at Hove; Professor Hermann Schlegel, director of the museum of Leyden; Prof. H. C. Berghaus, the well-known geographer, in his eighty-seventh year, at Stettin, Feb. 17; Quintino Sella, president of the *Accademia dei lincei*, at Biela, March 14; and Dr. E. Behm, the geographer.

— M. Adams, says the *Athenaeum*, has successfully established an optical telegraph between the islands of Mauritius and Reunion, a distance of two hundred and forty-five kilometres. Observers in Mauritius can read the signals without difficulty, and the arrangements for announcing cyclones are in process of completion.

— Russia has two polar stations on Weyprecht's plan, — one at Sagastyr (the mouth of the Lena), and the other at Little Karmakuly, Moller Bay (the west coast of Novaia Zemlia). According to the latest news, which is, as may be understood, slow to reach St. Petersburg, the Lena station was in good condition, and is to be continued until July, 1884. Thus the stations which are most interesting and most difficult to reach (the Lena and Lady Franklin Bay) will have the longest course of observations. The Novaia Zemlia station has finished its observations; and the members, consisting of Lieut. Andrejew, Midshipman Wolodkowsky, Drs. Grinewetzky, Kriwoskeya, and seamen, have returned.

Lieut. Andrejew, in a lecture before the Geographical society, gave the following facts in regard to the station. The latitude of the station was determined by observation of the sun and stars; the longitude, by double chronometer comparison between Karmakuly and Archangel. The observations comprised hourly reading of the magnetic and meteorological instruments, with more frequent reading of the former on stated days and during magnetic disturbances. The results have not yet been calculated. Scurvy was prevented by exercise and the use of good fresh food, and the health of all was good. The death of one seaman happened under somewhat strange circumstances: he disappeared, and after long search was found undressed, in the snow, with his legs frozen. They were amputated, but he died soon after.

— We have already referred to the observations of Lessar in regard to the character of the valley or depression which had been regarded as an ancient channel of the Oxus, south of Khiva. From Bala Ichemi he turned to the eastward, to Kavakli, on the Amu Daria, and, according to letters just received, found no trace of any ancient river-bed. Gen. Stebnitzki and other explorers of this region do not accept as yet the opinion of Lessar in this particular.

— A very interesting addition to the mollusca of the United States is made by Stearns, who describes, in the *Proceedings* of the Philadelphia academy, Pyrgula nevadensis, from specimens obtained by Xenos Clarke and R. E. Call, at Pyramid and Walker's lakes, Nevada. The species is found living in the depths of the lakes, and fossil on the shores; but the specimens collected all appear to have been destitute of the soft parts, for which reason the generic relations cannot be said to be definitely settled, though probably correctly surmised. A fossil shell had previously been described from the post-pliocene of Illinois, by Wolf; but its affinities may be said to be very imperfectly determined. The identity of Tryonia clathrata Stm. with Amnicola protea of Gould, which Mr. Stearns seems to consider as undoubted, is deserving of further investigation at least; as in many thousands of the latter we have never seen a specimen of Tryonia, or any approximation to one, judged by the standard of Stimpson's original specimens and figures.

— Professor Boyd Dawkins reports the discovery of a skull of the musk-ox (Ovibos moschatus) in the forest-bed of Trimingham, near Cromer, — a formation which is believed to be certainly preglacial. The discovery is considered to add to the evidence that the glacial epoch does not represent a condition of environment separating two distinct faunas.

— The agricultural and mechanical college of Texas has issued a bulletin in which it calls attention to the need of a more careful study of the agricultural necessities of the state, and offers the advantages of the college for analyses of soils and fertilizers, and experiments on methods of feeding, on the grasses suitable to Texas, etc. A special request is made for samples of wool.

— It is stated that Senhor Antonio Lopez Mendes is about to undertake an important study of the Amazon basin, including the main river and its affluents to their westernmost extension.

— Vols. v. and vi. of the census reports, comprising the report upon cotton-production by Prof. E. W. Hilgard, have just issued from the government printing-office. These volumes contain respectively 924 and 848 pages, and are amply illustrated with maps showing density of cotton-production and classes of soils. The great degree of attention given to this branch of agriculture by the census is amply warranted by the importance of this industry, the product of which, during the census year, was valued at nearly $300,000,000. A happier selection than Professor Hilgard for carrying on this investigation probably could not have been made. His long study of the geology and soils of the lower Mississippi states, with the agricultural methods practised there, enabled him to bring to this work a vast store of knowledge which was directly applicable to the subject.

The report is in two parts. The first contains a chapter on the general subject of cotton-culture in the United States; an extended table of measurements of cotton fibre from all sections of the cotton-belt; a chapter on the uses of cotton-seed and cotton-seed oil, and one upon soil investigations. The body of this part is taken up with the detailed report upon cotton-culture in the states of Louisiana, Mississippi, Tennessee, Kentucky, Missouri, Arkansas, and Texas, and Indian Territory. Part ii. consists of similar

reports upon Alabama, Florida, Georgia, South Carolina, North Carolina, and Virginia. An appendix to part ii. contains notes upon California, Utah, Arizona, and New Mexico, considered in relation to their possibilities as cotton-producing states or territories. Of these detailed reports, Professor Hilgard, besides planning and supervising all, wrote those upon Louisiana and Mississippi, and the notes upon California, etc. To Prof. R. H. Loughridge were assigned those upon Georgia, Missouri, Arkansas, Texas, and Indian Territory; to Prof. James M. Safford, Kentucky and Tennessee; to Dr. E. A. Smith, Alabama and Florida; while Prof. W. C. Kerr contributed the reports upon North Carolina and Virginia, and Major Harry Hammond that upon South Carolina.

All these state reports, with the exception of that relating to South Carolina, are upon the same plan. Each opens with tables of the leading agricultural statistics of the state. Then there follows a description of the topography, climate, and soils, with numerous analyses of the latter, — a subject to which Professor Hilgard is disposed to attach great importance. This is followed by agricultural descriptions of the several counties, and by cultural and economic details, which are derived from answers to schedule questions.

The report upon each state is followed by an index, evidently with the intention of making a separate issue of each report; and the entire report is closed with a very complete general index.

— Mr. Isao Iijima, a Japanese student under Professor Leuckart, has recently submitted a dissertation to the University of Leipzig for obtaining the degree of Ph.D. The judgment passed by the examining committee was, "Dissertatio, egregia — Examinatio, summa cum laude." Mr. Iijima has won his degree within two years from the time of his arrival in Germany. Students usually require from two to three or more years to accomplish the same end.

— The Johns Hopkins university circular for March prints an unusual number of scientific notes, abstracts of papers read before the various associations to which the active life of the university has given birth. It notes, also, the formation of a new archeological society, and of the purchase of a considerable mineralogical collection, which has been placed in charge of the associate in mineralogy, Dr. G. H. Williams. Extracts are given from Dr. Hartwell's address on physical culture at the opening of the new gymnasium last December, and of a lecture on the influence of athletic games on Greek art, by Dr. Waldstein of Cambridge, Eng. Plans are printed of the new chemical laboratory, and announcements are made of a series of fifteen lectures on classical archeology, now just closing, by Dr. Waldstein, Professor Gildersleeve, Dr. Emerson, and Messrs. Clarke and Stillman. A similar related series of sixteen historical lectures on chemistry is in progress, participated in by ten persons.

— A new species of trap-door spider, a species of Cteniza, has been discovered at San José, Cal. The common though little-known species of southern California is known as C. californica; and its trap-door nest is usually placed in museums beside the tarantula (Mygale Hentzii), and erroneously labelled as the tarantula's nest. This popular error, by which dealers in curiosities generally profit, is stranger, since the tarantula is usually too large to enter the nest of Cteniza, and itself makes no nest, occupying crevices in the ground or under stones, spinning a small web.

— The Boston society of natural history announces that the seaside laboratory, at Annisquam, Mass., will be open to students during the coming summer from June 20 to Sept. 1. The purpose of the laboratory is to afford opportunities for the study of the development, anatomy, and habits of common types of marine animals, under suitable direction and advice. There will be no attempt to give lectures nor any stated courses of instruction. Those who have had some experience in a laboratory, who have attended practical lessons, or who have taught in the schools, are sufficiently qualified to make use of this opportunity. The work will be under the immediate care of Mr. J. S. Kingsley during June and July, and Mr. B. H. Van Vleck during August. Applications should be addressed to Professor Alpheus Hyatt, Boston society of natural history.

— Koban is the name of an ancient necropolis in the Caucasus, explored by Chantre in 1882, and said by him to be the most interesting in that region. In 1869 a flood took away a part of the hill of Koban; and the owner, one Kanoukoff, an Ossete, discovered along the portion of the hill left, bones and objects of metal. Finding that they were not gold, he sold them to the museum of Tiflis. For several years this site has been dug by local archeologists; and in 1882 Chantre commenced a systematic exploration. Koban is a little Ossete village, three thousand metres above sea-level, on Tagaour Mountain, thirty-five kilometres distant from Vladikawkaz. The necropolis occupies two hectares. Transverse ditches from one to three metres deep disclosed twenty-two sepultures. Simple inhumation without incineration had been the mode of burial. The coffins were of plank or stone, and were not oriented. The bodies lay doubled up, and on the right side. More than three thousand objects have been recovered, mostly of bronze: of these, Chantre secured sixteen hundred and ninety-seven. The list includes articles of the toilet, arms, and utensils. The origin and the antiquity of these objects are alike unknown, a diversity existing between the contents of this and other cemeteries in the same region. Ethnological comparisons and classical allusions lead to the supposition that the ancient Ossetes came from the Caspian Sea. These people live now in the centre of the Caucasus, in the defiles, more or less rugged, of Mount Kasbeck. There remain only a hundred thousand of them. Those of the north present some resemblances to the Kabardians and Tchitchens, who surround them. Those of

the south borrow from their neighbors, the Georgians, some of their usages.

—*Terramares* is an Italian archeological term, adopted into the French scheme of Mortillet and Chantre with an appropriate symbol. Castione, the most noteworthy of the Italian terramares, is a hillock on a plain in the province of Parma, three metres higher than the surrounding area. Its former inhabitants, aiming to avoid places subject to inundation, halted upon this low plateau of bluish clay, not yet covered with the deposit of alluvium. The space occupied by the village, or settlement, was somewhat rectangular, containing about nine thousand square metres, and was enclosed by a ditch, or basin, oriented, its axis deviating thirty degrees from north to south. The first palafitte constructed over this broad ditch was floored with puncheons covered with calcareous sand, whereon were built huts of wood or straw. Through holes in the floors were thrown ashes, cinders, refuse of all kinds. Of course, when this process had filled up the space beneath, the people had to burn their rude huts, draw up the piles, and commence over again. From the relics found in the terramares, it is possible to derive some notion of the time of their construction, which seems to have had its beginning in the age of stone, and extended through the age of bronze. If it reached the age of iron, it was when the last layer was forming. Pigorini regards unfavorably the opinion that the basins surrounding the terramares were systematically fed by streams of water.

—Whoever studied the Tunis department of our centennial exhibition, saw a large, thick plank, whose under surface was thickly set with teeth of chipped flint. This was the *tribulum* (a Latin word, meaning a threshing-sledge, whence the word 'tribulation'). We are not surprised to see this old threshing-sledge in use in northern Africa. Indeed, it is one of the delightful cases of survival that so often spring upon us. Mr. Léon Didelot has written a chapter on this implement (*Bull. soc. anthrop. Lyon*, ii. 75) in which he not only describes one minutely, but quotes the writings of numerous early writers on the subject.

—The Royal society of New South Wales offers its medal and a money-prize for the best communication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects. 1°. To be sent in not later than Sept. 30, 1884: Origin and mode of occurrence of gold-bearing veins and of the associated minerals, the society's medal and twenty-five pounds; Influence of the Australian climate in producing modifications of diseases, the society's medal and twenty-five pounds; The infusoria peculiar to Australia, the society's medal and twenty-five pounds; The water-supply in the *interior* of New South Wales, the society's medal and twenty-five pounds. 2°. To be sent in not later than May 1, 1885: Anatomy and life-history of Echidna and Platypus, the society's medal and twenty-five pounds; Anatomy and life-history of Mollusca peculiar to Australia, the society's medal and twenty-five pounds; The chemical composition of the products from the so-called kerosene shale of New South Wales, the society's medal and twenty-five pounds. 3°. To be sent in not later than May 1, 1886: The chemistry of the Australian gums and resins, the society's medal and twenty-five pounds. The competition is in no way confined to members of the society, nor to residents in Australia. The communication, to be successful, must be either wholly or in part the result of original observation or research on the part of the contributor. No award will be made for a mere compilation, however meritorious in its way.

—M. Grunes has published in *La métallurgie* the result of a year's researches on the oxidizability of iron and steel under the influence of moist air, fresh, sea, and acidulated water. The numerous results are in the highest degree instructive. We can only state that iron is dissolved rapidly by sea-water, cast-iron losing about half as much as steel, and that *spiegeleisen* is the most powerfully acted on by sea-water.

—A circular has been issued by a committee of the Mechanical science section of the American association, urging all engineers and others interested to make the meeting of the section at Philadelphia a notable one.

—The programme of observations of the small planets Victoria and Sappho in 1882, for determination of the solar parallax, drawn up by Dr. David Gill, her Majesty's astronomer at the Cape of Good Hope, appears to have met with general favor at the hands of astronomers in different parts of the world. The latest contribution of observations is a series published in No. 2574 of the *Astronomische nachrichten* (band 108), made by Professor Kurt Bohlin at the observatory at Upsala. The observations were begun early in August, 1882, and continued for somewhat more than two months.

—Every member of the group of small planets discovered up to the present time has now a name; No. 233, discovered by Borelly at Marseilles, May 11, 1883, having received the name Asterope. The elements of the orbit of No. 235, Carolina, have been determined by Professor Frisby.

—Dr. Finsch's account of the anthropology of the South-Sea Islands has just been published by Asher of Berlin. Dr. Finsch secured no less than a hundred and sixty-four casts of the faces of the inhabitants from sixty-one different islands: so his facts will not rest on individual observation alone. These casts have been on view at the Berlin 'Panopticum.'

—The use of the dynamo-electric machine for the ventilation of mines is reported from Saxony. At the Carola pits, Messrs. Siemens and Halske, the German electricians, have inaugurated the system. At the pit bank a dynamo is stationed, which is coupled up by shafting with the engine. By means of copper conductors, this machine is connected with another dynamo, two thousand five hundred feet away in the depths of the mine. This latter is connected with a powerful centrifugal fan. The cost of working these combined machines is six shillings and threepence per day, which means threepence for every million cubic feet of air delivered.